DOCUMENT RESUME

ED 167 721 CE 018 783

AUTHOR Kleine, Richard E.; Hamme, Randall
TITLE Curriculum Guide, C.E.I.T.--Ninth Grade, Transportation Technology. Point Pleasant Junior High School, Point Pleasant, West Virginia, 1977-1978.
INSTITUTION Mason County Schools, Point Pleasant, W. Va.; West Virginia Univ., Morgantown. Coll. of Human Resources and Education.
SPONS AGENCY West Virginia State Dept. of Education, Charleston.
PUB DATE Jun 78
NOTE 140p.; For related documents see CE 018 781-784

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS *Career Exploration; Course Content; Educational Objectives; Energy; *Grade 9; Junior High Schools; Learning Activities; *Learning Modules; Metric System; Motor Vehicles; Performance Based Education; Resource Materials; *Technology; *Trade and Industrial Education; *Transportation
IDENTIFIERS *Project Open; West Virginia

ABSTRACT

The result of a curriculum development project known as Project Open, this curriculum guide offers an elective course on transportation systems for ninth graders who are participating in the Career Exploration in Technology (CEIT) program and who have completed the eighth-grade course on manufacturing systems. The course, which spans two semesters, includes the following units: (1) an introduction, (2) history of land transportation, (3) energy, (4) transporting people, (5) freight transportation, (6) future trends in land transportation, (7) water transportation, (8) air transportation, (9) space transportation, and (10) transportation systems. Each unit gives an overview of its topic and an objectives statement, followed by a detailed content outline, suggested time span, relevant resources, and a list of activities supportive to the content. The types of activities vary from class discussions, films, and demonstrations, to student design and construction of vehicles and their components. Some units also contain pre- and posttests. Elective units are also included on the metric system and alternative sources of energy. A film list is provided at the end, as well as the names and addresses of supplier of free and inexpensive materials to be used in the course. (For the final report of the project that developed this guide, see CE 018 781.) (ELG)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED167721

CURRICULUM GUIDE

C.E.I.T.-NINTH GRADE

TRANSPORTATION TECHNOLOGY

POINT PLEASANT JUNIOR HIGH SCHOOL

POINT PLEASANT, WEST VIRGINIA

1977-1978

Prepared by

Richard E. Kleine and
Randall Hamme
Training Associates

Under the direction of

Dr. David L. McCrory
Coordinator of Field Services

Technology Education Program
College of Human Resources and Education
West Virginia University
Morgantown, West Virginia

June, 1978
West Virginia University

CE 015 733

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

West Virginia Board of Regents

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

TABLE OF CONTENTS

page

Preface. i

Project Personnel. ii

Introduction 1

Transportation Course Description. 1

Curriculum Objectives. 2

Content Structure. 4

Unit I. Introduction to Transportation Technology 5

Unit II. History of Land Transportation 11

Unit III. Energy. 18

Unit IV. Transporting People. 33

Unit V. Freight Transportation. 41

Unit VI. Future Trends in Land Transportation 46

Unit VII. Water Transportation. 50

Unit VIII. Air Transportation 56

Unit IX. Space Transportation 67

Unit X. Transportation Systems. 70

Elective Units 73

Film List. 87

Free and Inexpensive Materials 94

PREFACE

This curriculum guide is the result of a curriculum development project known as "Project Open." The project was a cooperative effort between the Technology Education Program at West Virginia University and the Mason County Schools.

The course, one of two developed for ninth graders in Mason County, is based on the study of transportation systems. It was developed expressly for ninth grade students at Point Pleasant Junior High School, and was tested over a three year period in the classroom. As part of a multi-year program of Career Exploration in Technology (CEIT), this course is elected by students after having completed an eighth grade CEIT course based on the study of manufacturing systems.

The basic intent of the course is to expand student knowledge about the technological world around them. It is designed to take advantage of the local resources of the Point Pleasant community and the interests of Point Pleasant students. At the same time, the content is based on timeless, technology concepts known to be transferrable to new places and new situations in the future.

We recognize that the support and suggestions of many individuals were necessary for the development of this course. We are indebted to the Point Pleasant Junior High School students who piloted the course, to the project personnel who shared their expertise, and to the Mason County School officials who supported the project. We are proud to have been a part of a great team effort.

David McCrory
June, 1978

PROJECT PERSONNEL

Virgil Burris, Principal
Point Pleasant Junior High School
Point Pleasant, West Virginia

Lowell Cook, Superintendent
Mason County Schools
Point Pleasant, West Virginia

Paul W. DeVore, Chairperson
Technology Education Program
West Virginia University

J. Barry DuVall, Project Advisor
Technology Education Program
West Virginia University

William A. Edwards, Assistant Director
Vocation Education, Mason County Schools
Point Pleasant, West Virginia

Randall Hamme, Curriculum Developer
Technology Education Program
West Virginia University

Richard E. Kleine, Curriculum Developer
Technology Education Program
West Virginia UNiversity

David L. McCrory, Project Director
Technology Education Program
West Virginia University

James F. Snyder, Project Advisor
State Department of Education
Charleston, West Virginia

A. E. Sommer, Director
Vocational Education, Mason County Schools
Point Pleasant, West Virginia

Richard Workman, Assistant Principal
Point Pleasant Junior High
Point Pleasant, West Virginia

INTRODUCTION

The "Project Open" concept was developed by the Technology Education Program at West Virginia University for the Mason County Public School system. The function of the project was to provide technology-based curricula in schools which previously had no industrial arts or technology-based curricula.

Two doctoral level graduate students were employed to design, develop, implement, evaluate and revise a technology-based curriculum during a three-year period. As part of their task (implementation) each of the two graduate students was required to take up residence at the project site and perform the duties of a full-time teacher one semester of each school year. At the end of the third year, the curriculum was transitioned to a full-time teacher for the future continuation of the developed curriculum.

The institution of the Project Open curriculum development projects in Mason County, West Virginia, was in 1973 at Wahama Junior/Senior High School. This first project was implemented through an eighth grade general education course titled "Career Exploration in Technology" (CEIT). The content focus of this course was manufacturing technology. The following year a second eighth grade project was started at Point Pleasant Junior High School with a content focus of production technology. In 1975 two more projects were initiated in Mason County, one at each of the two project schools. Both of these projects were on the ninth grade level. The curriculum foci were communication (Wahama) and transportation (Point Pleasant).

The Career Exploration in Technology curriculum projects were initiated to provide students with opportunities to increase their understanding of the technological society in which they live. Individual and group hands-on activities were developed for the purpose of reinforcing the content covered in the class. The end result of the students' experiences in the class was to enable the student to better be able to exercise choice in the control and redirection of technology for humane purposes.

TRANSPORTATION
COURSE DESCRIPTION

The transportation technology curriculum at Point Pleasant Junior High School was developed as a one-year (two semester) course for ninth grade students. The course was designed to give the student a broad perspective of the area of transportation and the career opportunities which exist in that area. A study of vehicle systems

and principles of operation as well as the technical and social problems which occur from their use are covered in the course. Future trends and alternatives in transportation are also included.

In Figure I, a paradigm is provided to illustrate the general areas of focus in the curriculum. It should be noted that technological man is placed at the top of the paradigm to signify his position as the creator and user of technology. The history and development of transportation have been included to establish a basis for understanding why things are the way they are. Power, as one of the most crucial of all components of transportation, has always been a dominating factor in the development and continued growth of transportation. For this reason, power (propulsion systems) is separated from other systems to allow a more concentrated analysis. Vehicle systems follow in the content structure and is related to use in society and the effects which occur as a result of this use. All of the above-mentioned units are then synthesized in a final unit and from this synthesis possible future alternatives are identified.

CURRICULUM OBJECTIVES

The curriculum was developed around seven broad objectives. These objectives were shared by all Project Open director implementor models.

1. To provide students with technological awareness through an examination of human creation and use of technology in an attempt to control the environment.

2. To provide students with a variety of experiences aimed at using an organized, systematic method of inquiry to solve problems.

3. To provide students with a variety of experiences that will reinforce the development of skills in reading, writing, and computational ability.

4. To develop in each student a positive attitude toward safety.

5. To provide students with a variety of group activity experiences in which the student will learn the importance of cooperation and group effort.

6. To develop in students, an awareness of their own career potential as it relates to the world of work.

7. To develop in each student an awareness of transportation and its place in our society.

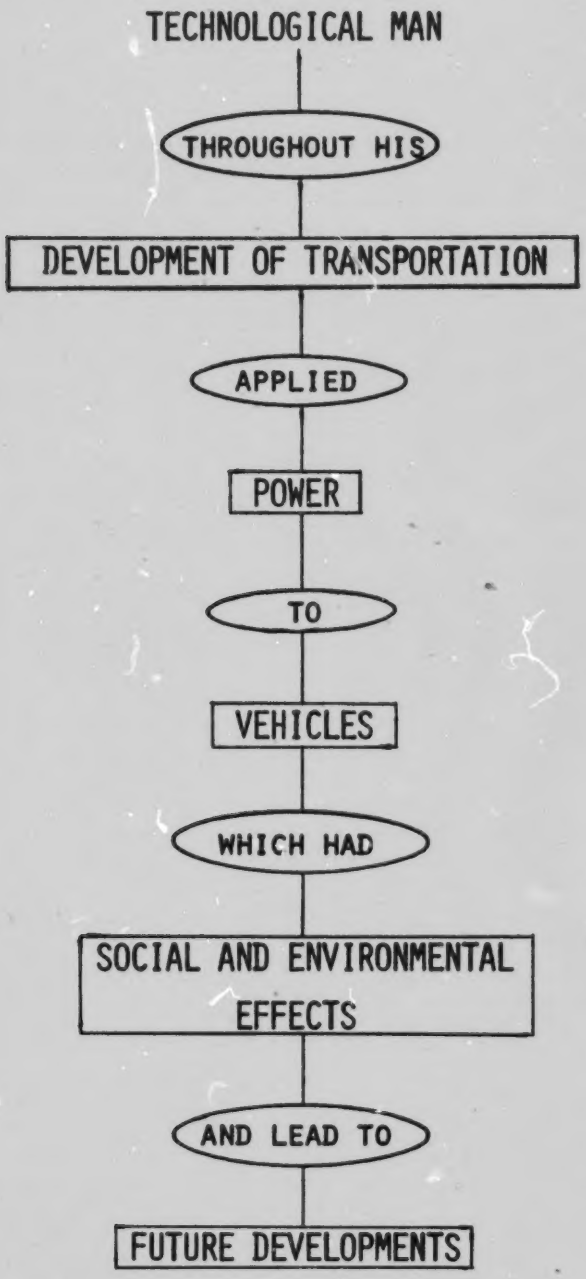

TECHNOLOGICAL MAN
THROUGHOUT HIS
DEVELOPMENT OF TRANSPORTATION
APPLIED
POWER
TO
VEHICLES
WHICH HAD
SOCIAL AND ENVIRONMENTAL EFFECTS
AND LEAD TO
FUTURE DEVELOPMENTS

Figure 1

CONTENT STRUCTURE

The content area of transportation has been divided into three sub-areas to facilitiate the organization of the curriculum. These sub-areas are related to the environments in which the transportation takes place. See Figure II. These environments (land, water and air/space) are related to the implementation of the curriculum. Each is covered individually beginning with land transportation and ending with air/space transportation. For reasons of convenience and the relationship of the two, air and space have been combined.

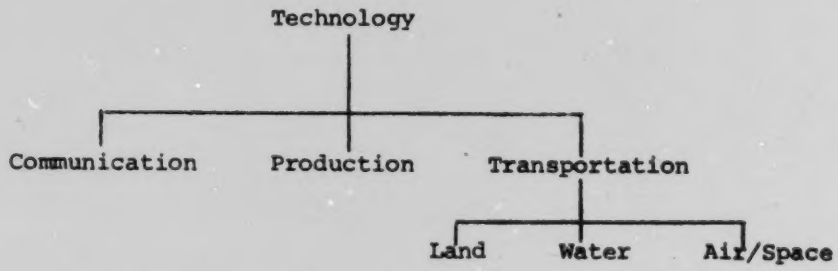


Figure II

Content Structure

The following is a list of the units which comprise the transportation curriculum. These units are presented with a brief overview of the nature and importance of the unit, the purpose for including it in the curriculum and the objective of the unit. This is followed by a detailed content outline, suggested time span, relevant resources and a list of activities supportive to the content.

UNIT I

INTRODUCTION TO TRANSPORTATION TECHNOLOGY

Unit Length: 5 class meetings

Transportation has long played a part in the directing and advancing of civilization. The dependence of society on transportation is greater today than ever before. Yet it is doubtful that very many people fully understand or appreciate the transportation network which provides for their needs. Nor do they understand the present shortcomings and problems which exist with the present transportation network.

The purpose of this unit is to acquaint the student with the need and function of transportation in our present day society. Key terms necessary to the understanding of the function and operation as well as some of the problems are identified and discussed. A brief introduction to the meaning of technology and its nature will proceed the transportation content. The section on technology will better enable the student to understand the basis for the study of transportation technology and its place in our technological society.

Unit Objective: To identify the need, function, and structure of contemporary transportation and to clarify the effects its use has had on society.

Unit 1-Introduction to Transportation Technology

Time Span	Content	References/Resources	Activities
2 class sessions	I. Introduction to Transportation Technology A. Technology 1. Definition a. Components b. Universality 2. Nature a. Level of complexity b. Rate of change c. Effects on society 3. Technical areas a. Communication b. Production c. Transportation	DeVore, Paul W. Education in a Technological Society. "Access to Tools," West Virginia University Technology Education Program, 1972, pp. 6-12, 29-31. Gould Inc. Technology: Abandon, Endure or Advance? Dialogues on Technology, No. 1. Kranzberg, Melvin and Carroll W. Pursell Jr. Technology in Western Civilization. New York: Oxford University Press, 1967, Vol. 1, pp. 1-11; Vol. II, pp. 3-10.	1. Lead a discussion having the students develop a definition of the term technology. 2. Have the students identify ways in which the lifestyle of a modern family has changed from that of a family in the 1920's as a result of improved technology. 3. From the above discussion have the students speculate on the future and how it will be different as a result of technology.
3 class sessions	B. Transportation 1. Purpose/Need a. National defense b. Economic development c. Community development 2. Classification a. Environment	Fair, Marvin L. and Ernest W. Williams Jr. Economics of Transportation and Logistics. Dallas: Business Publications, Inc., 1975, pp. 19-46. Danforth, Paul. Transportation. New York: Doubleday & Company, Inc., 1965, pp. 8-27. DeVore, Paul W. Education in a Technological Society. "Access to Tools." West Virginia University Technology Education Program, 1972, pp. 38-43.	4. Lead a disucssion on some of the problems which currently exist as a result of the application of technology. 5. Have students develop a 3 dimensional technology model. 6. Develop a working definition through a class discussion

Time Span	Content	References/Resources	Activities
	1. Terrestrial 2. Marine 3. Atmospheric & space b. Mode 1. Highway 2. Railway 3. Pipeline 4. Waterway 5. Airway c. Vehicle systems 1. Control 2. Guidance 3. Propulsion 4. Suspension 5. Structure 3. Problem areas a. Pollution b. Accidents c. Delay d. Conflict		of the meaning of the term "transportation." 7. Have students bring in pictures that "represent" transportation and display them on a bulletin board. Use the pictures to discuss the many ways of transporting people and goods. 8. Film: "Transportation: Projection 70," 24 minutes, color, 16mm no cost. Technology Education Research and Resource Center, Technology Education Program, West Virginia University, Morgantown, West Virginia 26506. 9. Film: "Transportation: Projection 70," 24 minutes, color, 16mm, no cost. Technology Education Research and Resource Center, Technology Education Program, West Virginia University, Morgantown, West Virginia 26506.

Abbreviations:

ERDA - Energy Research & Development Administration

FAA - Federal Aviation Administration

GAMA - General Aviation Manufacturers Association

MCMC - Mason County Materials Center
Point Pleasant High School
2312 Jackson Avenue
675-4226
Mr. Van Horn-Coordinator

PPJHS- Point Pleasant Junior High School
Ohio River Road
Pt. Pleasant, West Virginia 25550

TERRC- Technology Education Resource and Reference Center
2929 University Avenue
West Virginia University
Morgantown, West Virginia 26505

WVU - West Virginia University
Technology Education Program
609 Allen Hall
Morgantown, West Virginia 26505

Activity I - 5

Development of a Technology Content Model

To facilitate student understanding of the meaning of technology, a three dimensional educational aid is useful. The aid can be used throughout the semester as a reference as well as an initial introductory activity. It must be pointed out that this model is not a true representation of the realm of technology, but instead, one means of categorizing its context, contents and components into a synergetic relationship.

The model recommended in this activity is constructed from 4"x4"x20" lumber. We, in the department of Technology Education, have divided the study of technology into communication, transportation, and production. The context is divided into primitive (low technology), intermediate (medium) and super (cybernetic) technology. The components of technology are divided into energy, tools, materials, processes and information systems. Each of the non-labeled sides contain a variety of examples printed on colored paper (each color corresponding to the particular content, i.e. transportation, production and communication.

By dividing the class into three groups, one for each component, the students can generate examples other than those found on the model. By rotating one component each day, each of the groups are allowed to look at each content area as well as its complexity and related components. The fourth day can be used to have the students present their original area and defend the alternative examples in front of the class. The following page contains an example of one of the three components (transportation) in showing some possible examples.

EXAMPLE FORMAT IN TRANSPORTATION

TRANSPORTATION (Content)

SUPER/CYBERNETIC (Context)	INTERMEDIATE (Context)	PRIMITIVE (Context)
ENERGY (Component)	ENERGY (Component)	ENERGY (Component)
-fuel cells	-battery	-sails
-electric propulsion	-petroleum	-human muscle
TOOLS	TOOLS	TOOLS
-torque wrenches	-crankshaft	-pulley
-engine analyzers	-sockets	-wheel & axle
MATERIALS	MATERIALS	MATERIALS
-aluminum	-steel	-animal skins
-fiberglass	-glass	-wood
PROCESSES	PROCESSES	PROCESSES
-vulcanization	-petroleum distillation	-ship building
-flywheel energy storage	-wheel alignment	-tanning leather
INFORMATION	INFORMATION	INFORMATION
-radar/sonar	-brake lights	-maps
-traffic signals	-apprenticeship	-cultural transmission

UNIT 2

HISTORY OF LAND TRANSPORTATION

Unit Length: 15 class meetings

The role of transportation throughout history has been significant. Advances in mobility, speed and capacity have enabled travelers to overcome obstacles of distance, geographic boundaries and time. These advances have also brought about a more unified world through the cultural exchange which first began with early explorers and has continued through to modern times.

The purpose of this unit is to investigate the various stages of the history of transportation. This is achieved principally by reviewing key technical developments in the area of transportation. The use of these developments in society and the resultant effects is emphasized. In addition, the influence of the various technical developments on later developments is included. Other technical and social developments outside the area of transportation which had an influence are discussed.

Unit Objective: To identify major technical developments in land transportation and to determine their effects on the development of society.

Unit 2-History of Land Transportation

# Class Meetings	Content	References	Activity
15	II HISTORY OF LAND TRANSPORTATION A. INCREASING HUMAN CAPACITY 1. Sack 2. Carrying pole 3. Litter 4. Travois 5. Sledge 6. Rollers B. DEVELOPMENT OF ROLLING VEHICLES 1. Wheel a. Solid b. Plank c. Spoke 2. Axle a. Live b. Dead 3. Reducing friction a. Lubrication b. Bushing c. Bearing 4. Vehicle a. Types 1. Two-wheel 2. Four-wheel	Firestone, Harvey S. Jr. Man on the Move. New York: G.P. Putnam's Sons, 1967, pp. 11-35, 69-71, 72-81, 90-91. Association of American Railroads. Challenges Accepted: The Story of Railroading. pp. 1-17. Encyclopaedia Britannica, 1977 ed. "Transportation", Volume 18, pp. 648-654. "Roads & Highways", Volume 15, pp. 892-895. Fair, Marvin L. and Ernest W. Williams Jr. Economics of Transportation and Logistics. Dallas: Business Publications, Inc., 1975, pp. 3-18. Kranzberg, Melvin and Carroll W. Pursell Jr. Technology in Western Civilization Vol. 1. New York: Oxford University Press, 1967, pp. 74-75, 291-302, 425-431, 520-522.	1. Primitive Vehicle - Mechanical Advantage Exercise. Dividing the students into groups of 3-4 have them complete a series of experiments designed to illustrate the advantages provided by the carrying pole, litter, travois, sledge and rollers. 2. Early Wheeled Vehicle. Divide the class into 5 groups and assign or accept volunteers to design and construct one part of an 18th-19th century 4-wheel wagon or coach. The class effort will represent one completed wagon. 3. Primitive Vehicle Design and Construction. Have the students working individually or in groups of 2 design a primitive transportation vehicle or device. All designs should be based on materials found in their natural state (e.g. vines, tree limbs, tree bark, rocks). Construction techniques should be limited to realistic methods of the time period of the vehicle.

# Class Meetings	Content	References	Activity
	b. Operation 1. Private 2. Public		
	C. UTILIZATION OF ANIMALS 1. Pack 2. Draft 3. Riding 4. Technical Developments a. Yoke b. Harness c. Horse collar d. Saddle		
	D. DEVELOPMENT OF ROADS 1. Origin 2. Construction design 3. Materials 4. Layout 5. Ownership		
	E. EMERGENCE OF THE RAILROAD 1. Early efforts a. Omnibus b. Freight Companies 2. Changes in motive power a. High pressure boiler b. Rocket c. Tom Thumb		

# Class Meetings	Content	References	Activity
	3. Formation of railroad lines a. Canal companies b. Baltimore & Ohio c. Camden & Amboy 4. Refinements in equipment a. Steam locomotive b. Rail design c. Car components/design F. SOCIETAL EFFECTS 1. Community development 2. National unity 3. Westward expansion 4. Time zones 5. Decrease of rural area		

Activity II - 1

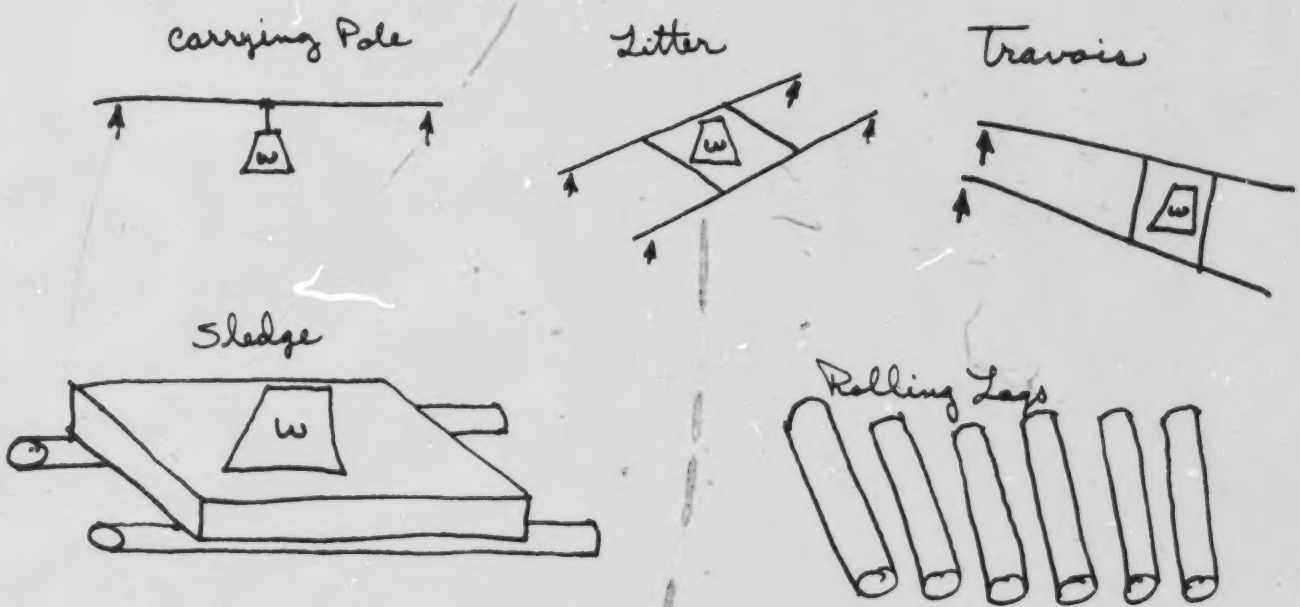
Title: "Primitive Vehicle - Mechanical Advantage Exercise"

Overview: Primitive humans developed various methods and devices to aid in their transportation. These devices were designed to take advantage of weight distribution, reduced friction and suspension.

Objective: The student will be able to experience the mechanical advantage provided by various primitive transportation devices and to reinforce his/her skills in measurement using both English and metric systems.

Materials:
2 - ¼ x ¼ x 12" wood strips
2 - ¼ x ¼ x 4" wood strips
1 - ¼ x ¼ x 6" wood strips
1 - 1 x 2 x 3½" wood block
8 - plastic drinking straws
1 - 12" rule with metric scale
1 - 0 to 250 gram spring scale
1 - roll of masking tape
1 - roll of kite string

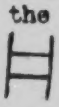
Design:



Name.
Period: Date: 16

Primitive Vehicles Exercise

1. "Carrying Pole"
Select one 12 inch wooden pole and find the center. Attach a 6½" piece of string by tying one end of the string to the middle of the pole. Tie the other end to the metal weight. Measure the weight supported by one end of the pole.
one end of the pole without test weight ____g = ____oz
one end of the pole with test weight ____g = ____oz
length of pole in inches ____ = ____cm = ____mm
test weight ____g = ____oz
What would be the combined weight supported by each end of the pole? ____g = ____oz
What advantage does the carrying pole provide as a means of primitive transportation?

2. "Litter"
Select two 12" poles and two 6" poles. Find the exact center of each 12" pole and measure 2¼" on each side of the center. Using a 1" piece of masking tape, connect the 6" pole to the 12" pole and repeat until the finished connection of poles looks like this:  Next, center weight B in the middle of the "litter".

Supporting 3 of the corners of the litter, place the scale at the fourth and measure the weight supported at that corner. Repeat the measurement procedure for each corner and record the weights.
Corner 1 ____g = ____oz Corner 2 ____g = ____oz
Corner 3 ____g = ____oz Corner 4 ____g = ____oz
test weight ____g = ____oz
exact length of the two 6" poles ____in = ____cm = ____mm
____in = ____cm = ____mm
exact length of the two 12" poles ____in = ____cm = ____mm
Did the results reflect that the litter distributed the weight evenly between the 4 corners?
Besides distributing the weight, what advantage does the litter provide?

3. "Travois"
Select two 12" poles, 1 6" pole and one 3" pole. Measure 1 7/8" from one end of each 12" pole. Next, measure 3 3/8" away from that point. At the 1 7/8" point attach the 6" pole between the two 12" poles using a masking tape and at the 3 3/8" point attach the 3" pole. Place the weight B on the travois. Using a 3 5/8" piece of string, tie it between the two 12" poles at the lifting end of the travois. Using the scale, measure and record the weight which must be supported to lift the travois. Next, pull the travois a distance of 3 feet and measure the weight recorded.
lifting weight ____g = ____oz pulling weight ____g = ____oz
exact length of the 12" pole ____in = ____cm = ____mm
exact length of the 6" pole ____in = ____cm = ____mm
exact length of the 3" pole ____in = ____cm = ____mm
Were the two measurements the same? If not, which was greater and why?

4. "Sledge"
To the block of wood, connect the two 6" poles along the longest edges of the block so as to serve as runners. Place all test weights on the "sledge". Next, hook the scale around the nail and measure the pulling force. Using the straws provided as rolling logs again measure the pulling force for a distance of two feet.
pulling force ____g = ____oz Pulling force with rolling logs ____g = ____oz
size of block: length = ____in = ____cm = ____mm
width = ____in = ____cm = ____mm
thickness = ____in = ____cm = ____mm
What was the change in pulling force between the two methods? Was this about what you expected?

Activity II - 2

Title: "Early Wheeled Vehicles"

Overview: From the invention of the wheel around 3500 BC to the introduction of the automobile in the 1890's, the four-wheel wagon served as the main transportation vehicle for moving people and goods. The basic design remained virtually the same throughout the 5400-year period. This activity is designed to enable the students to be involved in a group effort (class) to design and construct a four-wheel vehicle (e.g. Conestoga wagon) and to investigate the principles upon which it was constructed and operated.

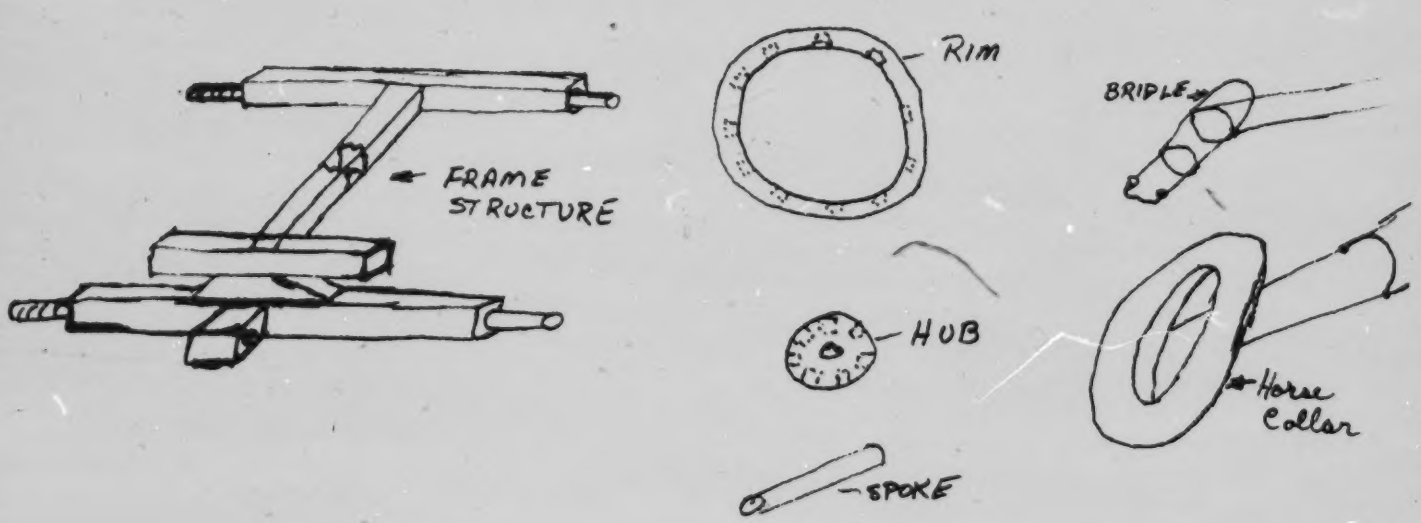
Objective: To enable the student, through group effort, to design and construct a one vehicle system of a four-wheel vehicle characteristic of the history of transportation.

Materials: (per wagon-one per class)

4 - ¼ x ¼ x 12" wood
1 - box craft stix (wagon body)
1 - approximately 12" x 12" cotton cloth (white)
1 - 1/8 x 3 x 12" balsa wood (spokes)
1 - 1 x 2" dowel (wheel hub)
1 - ¼ x 4 x 15" wood
1 - roll of kite string
1 - roll of heavy twine
1 - bottle of white glue

Note: Silhouettes of horses can be constructed from coat hanger material to hold the harness system.

Design: Systems
Control/Structure Suspension/Support Propulsion



UNIT 3

ENERGY

Unit Length: 30 class sessions

Energy is one form or another has been utilized by humans for thousands of years. Initially it was used to satisfy basic human needs for warmth and protection. As civilization developed, dependence on energy for communication, production and transportation purposes steadily grew. As new methods of energy conversion were developed, the benefits were evidenced in better communication, higher production and faster transportation.

From its origin the area of transportation had shown little improvement in the speed until the early 1800's. However, with the introduction of the steam engine and later the internal combustion engine, the speed, capacity and comfort of transportation vehicles increased dramatically. The refinements which have occurred since the 1800"s in the propulsion area have lead to a highly mobile modern society.

The purpose of this unit is to identify the various forms of energy and to investigate the principles of their use, the methods by which the energy is converted and the related advantages and disadvantages. Emphasis is placed on the present and future outlook for current energy sources and potential solutions in other energy sources not presently utilized or not used to full advantage.

Unit Objective: To investigate the principles of energy as they relate to the propulsion system of transportation vehicles and to identify current and future propulsion power units.

Specific Objectives:

1. To provide each student with a background of our present energy sources.

2. To identify the major energy conversion systems and how they are used to generate power.

3. To develop an awareness of the scientific principles of propulsion and power trains utilized by all transportation vehicles.

4. To enable students to identify the major types of alternative energy sources and how they are utilized to generate power.

Unit 3-Energy and Power

Time Span	Content	References/Resources	Activities
1 class session	III. Energy and Power A. Introduction to energy/power 1. Types of energy a. Potential b. Kinetic	Crouse, Wm. H. Automotive Engine Design. New York: McGraw-Hill Book Company, 1970, pp. 24-30, 31-43, 62-80. Bohn, Ralph C. and Angus J. MacDonald. Power: Mechanics of Energy Control. Bloomington: McKnight Publishing Company, 1970 pp. 13-28, 115-122, 124-130, 229-239. Summers, Claude M. "The Conversion of Energy," Scientific American. Vol. XXV, No. 3, September, 1971, pp. 148-160. Gould Inc. Technology: Whale Oil, Arab Oil, and No Oil. Dialogues on Technology #5, Rolling Meadows, Illinois: Gould Inc.	Have students in groups of 2's build working models of the various types of power units. Each group should be responsible for one type of engine/motor to construct and then present to the remainder of the class.
2 class sessions	2. Energy/Power Measurement a. Work b. Power c. Horsepower d. Efficiency	"Simple Machine: Work and Mechanical Advantage"-16 mm film (MCMC) "The Story of Power." General Motors Public Relations Staff (See Appendix B-4)	Student calculations of horsepower.
1 class session	3. Sources of Energy Introduction a. Continuous b. Exhaustible c. Replenishable (Fossil fuels, Hydro, Wind, Solar, Nuclear, Geothermal Mehane)	"Coal & Research Bulletin," National Coal Association. "About Coal Gasification." Consolidated Coal Company (See Appendix C-15)	

Time Span	Content	References/Resources	Activities
		"Facts About Oil." American Petroleum Institute. (See Appendix C-5).	
		"Energy-The Great American Experience." 16mm film, ERDA. (See Appendix B-2).	
	4. Conversions of energy to power a. Heat engines b. Electricity		
	B. Energy Conversions		Have students working individually or in groups of 2 construct working models of one of two steam turbines--a reaction turbine or an impulse turbine.
2 class sessions	1. External Combustion a. Piston b. Turbine	Walker, John P. Exploring Power Technology: Basic Fundamentals. Illinois: Goodheart Wilcox Co., Inc., 1976, pp. 191-197. (Copy ordered PPJHS library).	
		Engines 1610 (EE-2&3) transparency, MCMC.	Demonstration of piston steam engine. (Available in energy hardware box).
1 class session	2. Internal Combustion a. Piston (1) Two-stroke	Engines 1610 (EE-1) transparency, MCMC. Walker, pp. 49-66.	Demonstration/disassembly of model of two-stroke model aircraft engine. (Available in energy hardware box).
2 class sessions (variable)	(2) Four-stroke	Walker, pp. 67-96.	
		"ABC's of the Automobile Engine." 16mm film (excellent), G. M. (See Appendix B-4).	Set up a 4 cycle one-cylinder gasoline engine for operation/disassembly. Have students working in groups of 3-4 dissemble the engine

Time Span	Content	References/Resources	Activities
			and identify and make simple diagrms of the engine fuel, ignition, cooling, lubrication and cylinder/valve configuration as well as identify major engine components. (Briggs & Stratton 4-stroke engine ordered).
1 class session	(3) Diesel	Engine 1610 (EE-4) Transparency MCMC	
	b. Rotary	Walker, pp. 115-126.	
	c. Turbine	Film-"ABC's of the Diesel Engine." 14 minutes, c olor. 16mm, free loan. General Motors. (See Appendix B-4).	
2 class sessions	d. Jet (1) Turbo (2) Ram (3) Pulse	"How a Jet Engine Works" 35mm slide-strip, free. Ed. Services, American Gas Association. (See Appendix C-4). Available in Energy Software Box).	
		Walker, pp. 131-160.	
		"How Does a Jet Engine Work?" (exploded poster and booklet) Rolls-Royce Limited (See Appendix C-55)	
		"The ABC's of a Gas Turbine" General Motors. (See Appendix B-4).	
1 class session	e. Experimental designs	Ibid., pp. 199-203, 211-212	

Time Span	Content	References/Resources	Activities
5 class sessions	3. Electrical a. Motor b. Generator c. Storage	Hamme, Randall, and James Reynes, Jr. Electricity. West Virginia University, Morgantown. (This five day unit includes: What is electricity? How do we make it? How do we use it? The Language of Electricity. How do we control it? Xerox copy available at cost from TERRC. See Appendix A-1). Copy available in Energy Software Box. Electricity (ME 1-9) Transparency MCMC. Duffy, Joseph W. Power: Prime Mover of Technology. Bloomington: McKnight & McKnight Publishing Company, 1972, pp. 428-471. "Acting in Turn." 16mm film, Shell Film Library. (See Appendix B-8).	With students working in groups of 2-3 have them construct a small working motor using inexpensive materials. Have students disassemble a dry cell and identify the components. Have students construct a simple electro-magnet. Demonstrate electro-magnet principles using a coil of wire wrapped around a test tube. Use a galcanometer to indicate current flow while making and breaking a magnetic field with a bar magent. Using a band saw, cut a disgarded 12 volt battery (automatice) diagonally to show components for a demonstration aid.
2 class sessions	C. Propulsion Systems 1. Power 2. Transmission a. Gears b. Chain c. Belt 3. Drive a. Axle b. Wheel		

Time Span	Content	References/Resources	Activities
	c. Propeller d. Thrust e. Sail		
	D. Future Trends		
1 class session	1. Alternative Energy Sources a. Solar	Walker, John P. Exploring Power Technology: Basic Fundamentals. Illinois: Goodheart Wilcox Co., Inc., 1976, pp. 183-190.	Demonstrate the use of a radiometer, solar cell, fresnel lens. (Available in Energy Hardware box).
5 class sessions	b. Nuclear	Hamme, Randall L. Nuclear Power Generation. (A five day unit plan developed during the Electric Power Generation Workshop held at Franklin Institute Research Laboratories, August 26-30, 1974. Xerox copy available from TERRC at cost. Also, see Appendix 35). Atomic Energy (AE 1-6) Transparency MCMC	
	c. Bio-fuels	Auerback, Les. A Homesite Power Unit: Methane Generator. (See Appendix 30).	Instructor/student construction of a methane generator.
4 class sessions	d. Synthetic fuels e. Geothermal f. Wind	Walker, John P. Exploring Power Technology: Basic Fundamentals. Illinois: Goodheart Wilcox, Inc. 1976, pp. 213-214. Ibid., pp. 171-176.	Lecture/discussion/notes Construction of a Savonius

Time Span	Content	References/Resources	Activities
		"Preparing for Tomorrow's World." 16mm film. ERDA. (See Appendix B-2).	windmill and a bicycle-windmill.
2 class sessions	2. Energy Reserves a. Fossil fuels b. Nuclear 3. Environmental impacts a. Energy reserve depletion b. Air pollution c. Fuel waste 4. Effects on transportation a. Economics b. Performance c. Safety d. Dependability and convenience		

Activity III - 2

Activity on horsepower calculation

After studying and reviewing simple machines, work, power and horsepower, have the students calculate how much horsepower they can create in a specified time period. Secure several heavy objects such as 12" cinder blocks or cases of 36 ounce cans (from the cafeteria). Weight the containers on a bathroom scale. In order to standarize the distance for each student, substitute 3 feet for the distance each student will lift the object. Have the students place the object on the floor and staddle above it. Then, when given a signal by an official time keeper, have the students race against each other and the clock lifting the objects. It"s also helpful to have official counters for each participant.

By using the formula for work, calculate: WORK = FORCE X DISTANCE

WORK = 50 pounds X 3 feet (Object)

WORK = 150 foot pounds

Power is the rate of doing work. The formula for power is:

$$\text{POWER} = \frac{\text{WORK (Force x Distance)}}{\text{Time}}$$

Horsepower is the average working ability of a horse.

Hp = 550 foot pounds / second

or

Hp = 33,000 ft. lbs./minute - (60 sec.x550 ft. lbs.)

By substituting the work (150 ft. lbs.) X the number of repetitions (i.e.- 40 reps.) - 150 ft. lbs. X 40 reps. = 6000 ft. lbs. work

Now substitute this into the horsepower formula.

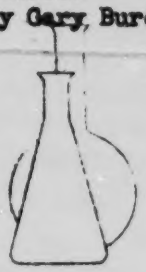
$$\text{Hp} = \frac{\text{6000 ft. lbs. work}}{\text{33,000 ft. lbs./min.}}$$

Hp = .181

Now ask the students if they were tired at the end of the minute. Point out that although they really worked hard, they still only achieved approximately 1/5 of what a normal horse would produce. Ask the students if horses get tired also. Now ask how much horsepower is generated by a lawn mower engine, a motor-cycle engine, a car or even a tow-boat (producing up to 10,000 Hp). How long can a prime mover generate power before it becomes tired?

Activity III - 3

Source: ENERGY - Time Life Series
Simplified and illustrated by Gary Burdette



27

PHYSICAL SCIENCE: ELECTRICITY AND MAGNETISM

TITLE: "Build an Electric Motor"

INTRODUCTION: Electric motors provide the power to move vehicles, run machines, and make many tasks easier for us to accomplish. Motors are based on the attraction and repulsion between a movable and a fixed magnet. By alternating the poles of the movable magnet, it will spin due to this push-pull action.

PURPOSE: To observe how an electric motor operates by building a working model.

MATERIALS:

1- wooden block - base
2- two large nails
3- several tacks
4- three paper clips
5- insulated wire
6- tape
7- battery

PROCEDURES:

1- Begin by bending a paper clip to form the armature as shown.

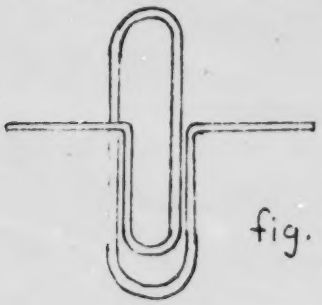


fig. 1.

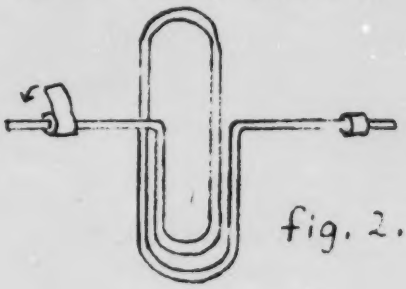
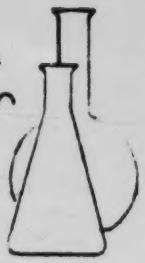


fig. 2.

2- Cut two narrow strips of tape and wrap around each end of the shaft to form spacers.



3- Next remove the insulation from one end of the wire.

fig. 3.

4- Now we are ready to wire the armature. Allow about ½ in. of the wire with the bare end to lie parallel to the shaft.

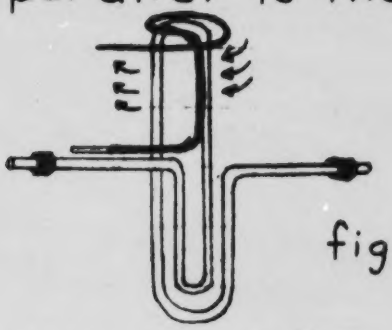
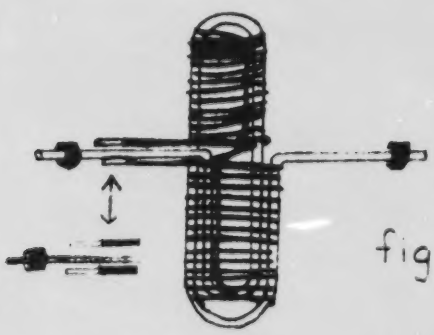


fig. 4.

5- Now begin to wind the armature as shown.

6- Continue to wind the armature until both sides are completed.

7- Bring the free end of the wire back down the armature and allow it to lie parallel to the shaft as you did in step 4.



* wires are beside but do not touch the shaft

fig. 5.

8- You *may* want to leave the wires unattached and not touching the shaft as shown. This forms the commutator.

9- Another way of making the commutator would be to use tape to insulate the shaft and attach the wires.

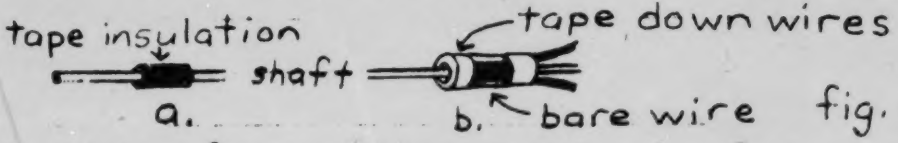


fig. 6.

10- Now form the supports from paper clips as shown. You will need 2.

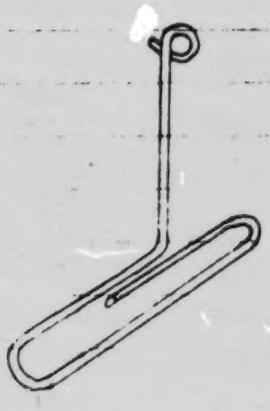


fig. 7.

11- Before you do any more wiring you should mount the supports and the nails for the electro-magnet on the board.

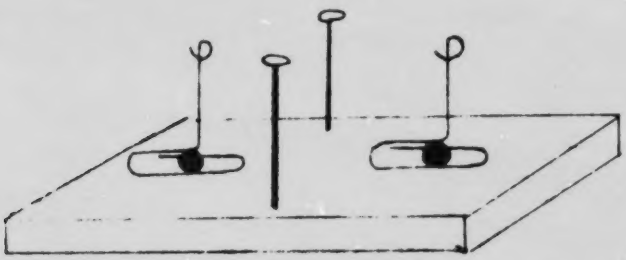


fig. 8.

12- Be sure the nails and supports are lined up and at 90° angles.

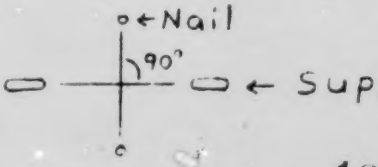
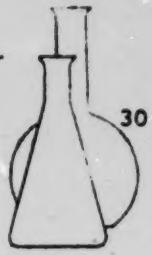


fig. 9.



13- Begin winding wire around the nails to form the stationary magnets.

14- Wind from the bottom to the top of the nail. Then wind back down the nail.

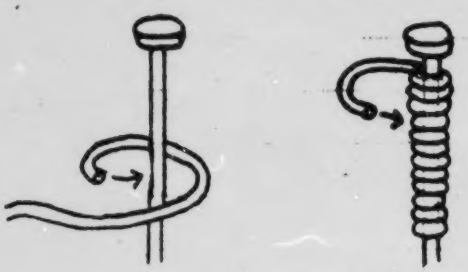


fig. 10.

15- Set up the brushes as shown below. Remember to remove the insulation from the end of the wires on each brush.

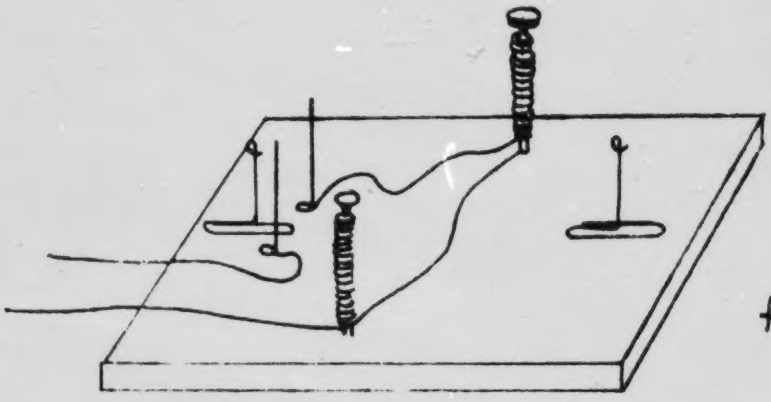
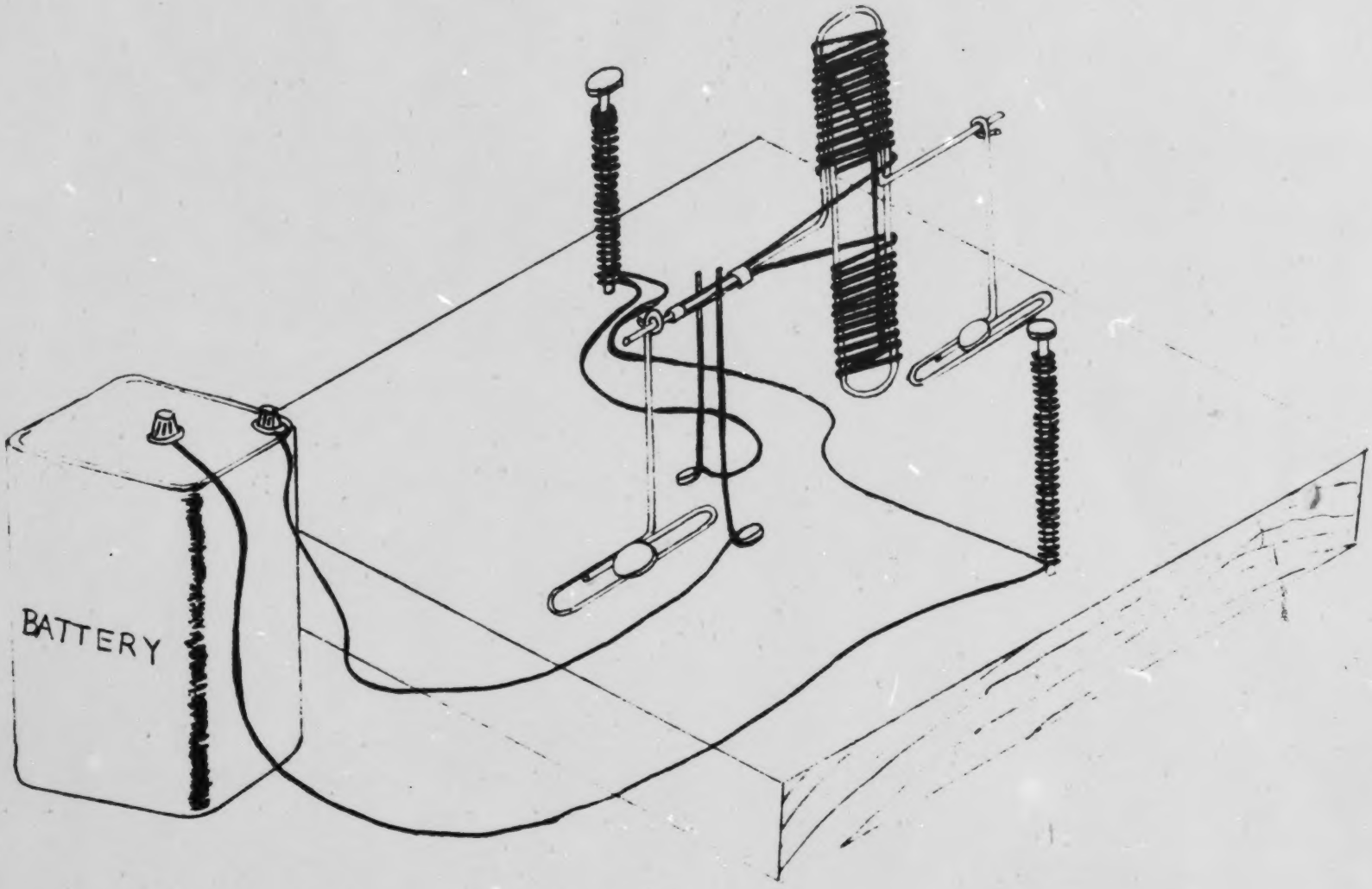


fig. 11.

16- Place armature in supports.
17- Adjust brushes, supports, etc.
18- Refer to figure 12 of the completed motor.
19- Additional adjustments may be necessary.

4.



Completed Electric Motor

Activity III - 4

Title: "Impulse and Reaction Steam Turbines"

Overview: Steam has provided power to do work since the 1600's. The developmental work of James Watt on the steam piston engine in the late 1700's enabled factories to move to areas where water power was not available. Later development lead to steam powered transportation vehicles such as the steam locomotive, steamship and steam powered automobile.

In the 20th Century steam has been utilized in turbines which turn generators to produce electricity. However, due to recent energy shortages steam is again a possibility for large scale transportation uses.

Objective: To acquaint the student with the principles of steam power and the methods of its application.

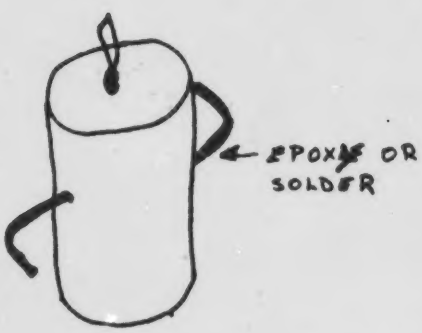
Materials: (per steam engine)

1 - small metal container (e.g. juice can)
2 - 1/8 x 3" brass tubing
1 - large fishing lure swivel

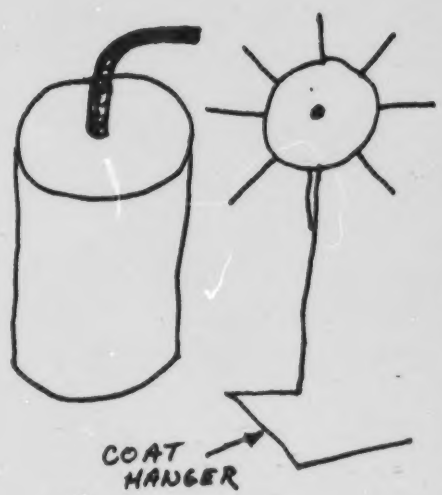
(heat source: propane torch)

1 - small metal container
1 - 1/8 x 4" brass tubing
1 - ½ x 2" cardboard disc
8 - ½ x 3/4" poster board pieces
1 - 14" coat hanger wire
(heat source: propane torch)

Design:



REACTION



IMPULSE

UNIT 4

TRANSPORTING PEOPLE

Unit Length: 15 class meetings

The United States has only 6% of the world's population, yet its citizens own over half of the world's automobiles. The automobile has had such an impact on this country that one out of every six businesses are directly related in some capacity with the automobile. This major influence did not develop overnight but was instead a continual process which began in the early nineteen hundreds. Prior to that time the horse and buggy, and to an increasing degree, the bicycle accounted for the majority of private transportation. Public transportation for intercity and interstate travel for the most part was handled by the railroads.

Although the automobile is not the only type of transportation available today, it is by far the most widely used. Buses, rail and other forms of public transportation have been able to marginally compete with the automobile in major population centers and then only for short distance travel. The fact that people in the United States have developed such a dependence on the automobile is reflected in the amount of space set aside for parking facilities within business areas. In addition to this, the redistribution of the population to the suburban areas is a sign of the transportation independence which has developed.

In this unit the various methods of transporting people will be identified. The principles of operation and vehicle systems will be investigated for each method. Emphasis will be placed on the influence of the automobile and the effects of its use on society and the environment.

Unit Objective: To identify and differentiate the various methods of transporting people on land and to determine the effects of their use.

# Class Meetings	Content	References	Activity
15	IV. TRANSPORTING PEOPLE A. NEED 1. Population Distribution 2. Business 3. Recreation B. METHODS 1. Personal/Individual 2. Public/Group C. PERSONAL TRANSIT VEHICLES 1. Bicycle a. Development b. Design c. Use and Operation d. Basis of the Motorcycle e. Influence on the Automobile 2. Automobile a. Mechanical Development b. Styling and Mechanical Improvement c. Vehicle Systems 1. Control 2. Guidance 3. Propulsion 4. Suspension 5. Structure	Fair, Marvin L. and Ernest W. Williams. Economics of Transportation and Logistics. Dallas: Business Publications, Inc., 1975, pp. 39-45, 107-111, 116-118. American Trucking Association. "The Geography of Survival." (Booklet) American Trucking Association, Washington, D.C. 12 pp. Wilson, S.S. "The Bicycle," Technics and Empirical Technology, March, 1973, pp. 55-65. Firestone, Harvey S. Jr. Man on the Move. New York: G.P. Putnam's Sons, 1967, pp. 136-195. General Motors Corporation. The Automobile Story. (Resource units) "The Automobile and You," "How an Automobile Works," "History of the Automobile." 1966. Kranzberg, Melvin and Carroll W. Pursell, Jr. Technology in Western Civilization, Vol. II. New York: Oxford University Press, 1967, pp. 119-148. Danforth, Paul. Transportation. New York: Doubleday & Company, Inc., 1965, pp. 29-59. Motor Vehicle Manufacturers' Association. Facts for Study. (Booklet) Detroit: Motor Vehicle Manufacturers' Association of the United States, Inc., 41 pp.	1. "Our American Crossroads," 12 minutes, 16mm color, free loan. General Motors Corporation Public Relations Staff General Motors Building Detroit, Michigan 48202 2. Have students read the programmed text on the history and development of the bicycle. "Development of the Bicycle," programmed text by John Ritz, Technology Education Research and Resource Center, West Virginia University, Morgantown, West Virginia 26506. 3. "Bicycles Are Beautiful," 27 minutes, 16mm color, free loan. Modern Talking Picture Service 910 Penn Avenue Pittsburgh, PA 4. Divide the students into groups of 3-4. Have each group complete a task at each of three stations by rotating all of the groups from one station to the next after a set period of time. At the first station have the students determine the 10 ratios for a 10-speed bicycle. At station two have the students measure the circumference of a bicycle wheel and determine how far it will travel in one revolution. Also have them disassemble and sketch a bendix type rear bicycle brake and then reassemble. At station three have the students sketch a bicycle and list the parts which influenced the design of early automobiles and

# Class Meetings	Content	References	Activity
	d. Benefits of use 1. Independence of mobility 2. Separation of work and home areas e. Controlling institutions 1. Law enforcement 2. DOT 3. NHTSA f. Roads and highways 1. Road design and layout 2. Interstate system g. Vehicle operation 1. Rules governing driving 2. Passenger safety	Association of American Railroads. America's Wheels. (Booklet) Washington, D.C.: Association of American Railroads, pp. 8-9, 12-14. Association of American Railroads. Railroads Now. (Booklet) Washington, D.C.: Association of American Railroads, pp. 10-11, 14.	determine the number of applications of bearings on a modern bicycle and list the type of bearings. 5. Mousetrap Vehicle. Present the students with a problem-solving situation in which they are to use a mousetrap as a source of power. Around the power source they will have to design a vehicle which will be evaluated on alignment, distance, traction and originality of design. Students can work individually or in pairs.
	D. PUBLIC VEHICLES 1. Bus a. Design - structure b. Operation 1. Capacity 2. Routing c. Use 1. Intracity 2. Intercity/state 2. Rail a. Vehicle 1. Propulsion 2. Passenger area		6. "UFO - Unrestrained Flying Objects," 14 minutes, 16 mm color, free loan. General Motors Corporation Public Relations Staff General Motors Building Detroit, Michigan 48202 7. Involve the students in a technology assessment task on some aspect of Personal Transportation (e.g. small automobiles, passenger restraint systems, air pollution controls). Refer to The Development and Testing of a Technology Assessment Methodology for Teaching Technology, Richard E. Kleine, unpublished doctoral dissertation, Technology Education Research and Resource Center, West Virginia University, Morgantown, West Virginia 26506.

# Class Meetings	Content	References	Activity
	b. Right of way 1. Suspension 2. Roadway design c. Operation 1. Terminal facilities 2. Route 3. Capacity d. Use 1. Intracity 2. Intercity/state		
	E. EFFECTS ON SOCIETY		
	1. Community development		
	a. Population distribution b. Industrial and business location		
	2. Population mobility		
	a. Recreation b. Relocation		
	F. EFFECTS ON THE ENVIRONMENT		
	1. Air quality		
	2. Energy usage		
	3. Natural resources usage		
	4. Land usage		
55	5. Congestion and overcrowding		

Activity IV - 4

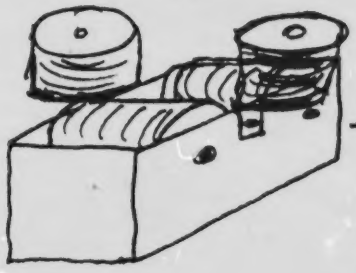
Title: "10-speed Bicycle Gear Ratio Measurement"

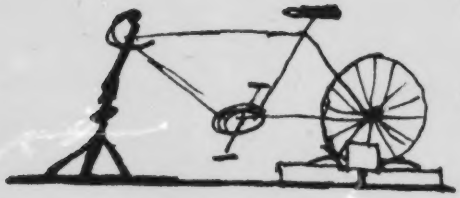
Overview: The 10-speed bicycle is the most efficient of all transportation vehicles and a common means of transportation for middle school students. Using a 10-speed bicycle, build a simple roller to support the rear wheel and have the students measure each gear ratio (for all 10 speeds). Have them then determine the distance for one revolution of the pedals in each gear.

Objective: To demonstrate the mechanical advantage which can be achieved through the use of gears (sprockets and chain) emphasizing the concepts of drive, power transmission and gear ratio.

Materials:
1 - 10-speed bicycle
2 - 1 x 4 x 10" wooden boards
2 - 1 x 4 x 4" wooden boards
4 - skate board ball bearing wheels or equivalent
2 - 1/8" x 3" steel "L's"
2 - 5/16 x 3" bolts (with nuts and washers)
2 - 5/16 x 6" bolts (with nuts and washers)

Design:





Activity IV - 5

Title: "Mousetrap Vehicle Design"

Overview: Place the student in a hypothetical situation in which he/she must design a vehicle using spring power. The vehicle will be evaluated on distance and alignment (how straight it runs). Other factors which should be considered in the design are: weight, traction and weight distribution.

Objective: To enable the student to design and build a vehicle which utilizes spring power.

Materials: (per vehicle)

1 - Mousetrap
3 - Wheels (# varies according to design)
1 - Coat hanger (axle)
2 - ¼ x ¼ x 12 pine wood strips per car
1 - roll kite string (approximately 6 " per car)
1 - roll masking tape (build up axle to hold wheel)
4 - Wire brad nails

Design: Attached.

NAME _____

TRANSPORTATION - PERSONAL TRANSIT

(Spring Propulsion)

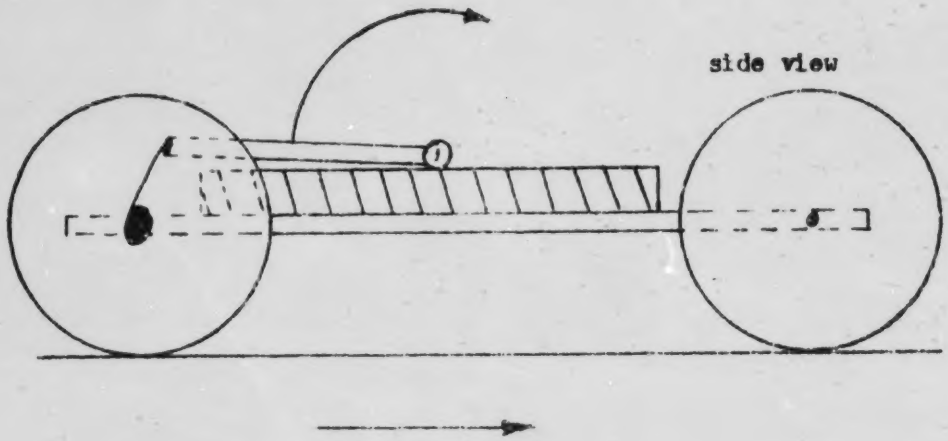
Directions: As the chief designer for a large auto manufacturer, your fellow engineers have just discovered a new and unique power source for transportation. This new power source has many advantages in that it is extremely economical, emits absolutely no pollutants because it does not consume petroleum or chemicals for fuel, and it produces high energy output for short intervals. The engineers have given you an accurate working model of this new power source, and oddly enough, it looks just like a mousetrap.

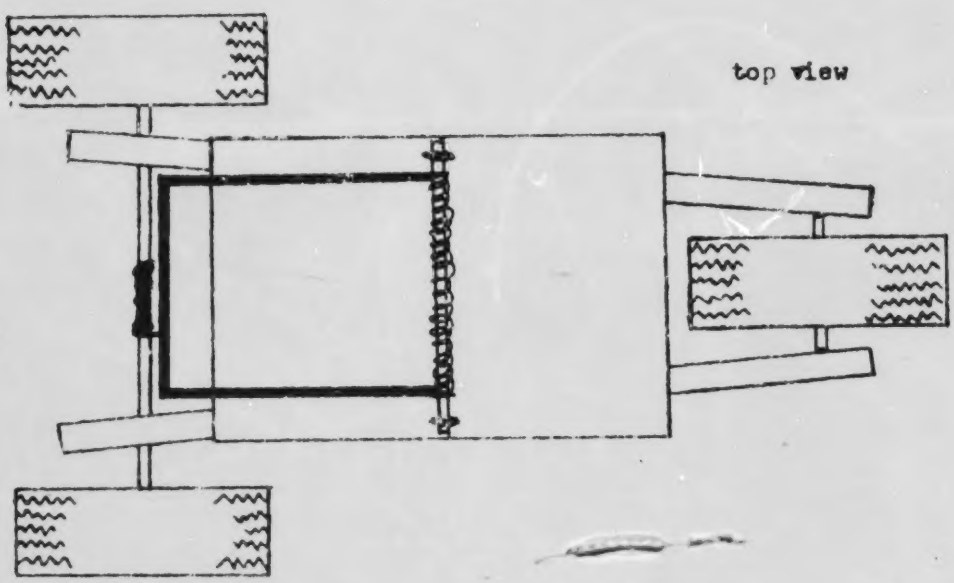
Your task is to design a working model of the finished vehicle using a mousetrap as the power source. As the designer, you must consider a variety of factors including: size, weight, speed, and distance. It may be some time before your company is ready to change over to mousetrap power. You should, therefore, use production methods and materials that are currently available.

On the following page appears one example of how this vehicle might be designed. You may use it to develop some beginning ideas for solving the problem. Use the space below to make a sketch of your vehicle design.

MOUSETRAP VEHICLE

(Design Example)





UNIT 5

FREIGHT TRANSPORTATION

Unit Length: 15 class meetings

The movement of goods from where they are found to where they are needed is the basis of freight transportation. Several methods of transporting a particular commodity are available to choose from in most instances. Factors of speed, capacity, reliability and cost are often used to determine the "best" method for a particular situation. The nature of the goods being moved is also an important factor.

Virtually everything we use depends to some degree on transportation. The sophistication of contemporary transportation makes it possible for large population centers to be supported by industries hundreds of miles away. It takes only a short stoppage in the flow of goods to the supported area to illustrate how great the dependence on transportation has become.

It is the purpose of this unit to identify and investigate the different modes of land freight transportation. Attention is focused on the principles and economics of vehicles and systems operation. Contemporary problems in the freight transportation area are addressed along with possible solutions.

Unit Objective: To identify and differentiate the various methods of transporting materials on land.

# Class Meetings	Content	References	Activity
15	V FREIGHT TRANSPORTATION A. INTRODUCTION 1. Purpose a. Support population centers b. Decentralized industry c. Decentralized natural resources 2. Types of freight a. Bulk products 1. High volume - low cost 2. Low volume - high cost b. Manufactured products 1. Multiple unit package 2. Single unit package 3. Economics a. Cost/mile b. Optimum unit c. Utilization of equipment d. Terminal and handling time B. MODES 1. Motor Freight (trucking)	Fair, Marvin L. and Ernest W. Williams. Economics of Transportation and Logistics. Dallas: Business Publications, Inc., 1975, pp. 48-61, 88-100, 224-234, 476-477, 485-487. Firestone, Harvey S. Jr. Man on the Move. New York: G.P. Putnam's Sons, 1967, pp. 181-184. Kranzberg, Melvin and Carroll W. Pursell Jr. Technology in Western Civilization, Vol. II. New York: Oxford University Press, 1967, pp. 129-130, 143-148. American Trucking Association. The Geography of Survival, American Trucking Association's Annual Report. (Booklets) Washington, D.C.: American Trucking Associations. American Trucking Association. TRUCKS and things you'll want to know about them. (Booklet) Washington, D.C.: American Trucking Association, 12 pp. Association of American Railroads. America's Wheels; The Human Side; Railroads Now; Railroads - Who Needs Them? (Booklets) Washington, D.C.: Association of American Railroads. Jenson, E.J. and H.S. Ellis. "Pipelines", Scientific American. Vol. 216, January 1967, pp. 62-70.	1. "Transportation - World Lifeline." 28 minutes, 16mm color, free loan. Public Relations Department American Trucking Associations 1616 P Street, N.W. Washington, D.C. 20036 2. Have the students read the booklet "Trucks" and then lead a discussion about the use of trucks in the freight transportation network. 3. "The Greatness of America." 12 minutes, 16mm color, free loan. Public Relations Department L & N Railroad 908 W. Broadway Louisville, KY 40201 4. Transparency set: "The Railroad Universe." 10 color polyethylene transparencies, free. Association of American Railroads Office of Information and Public Affairs 1920 L Street, N.W. Washington, D.C. 20036 5. Have the students, working in pairs, develop a freight transportation system for a city (teacher developed). Then have the students redesign the layout of the city to enable a more efficient transportation system.

# Class Meetings	Content	References	Activity
	a. Organization of the industry 1. Carrier types 2. Personnel b. Equipment 1. Trucks & trailers a. Propulsion b. Cargo units 2. Terminals c. Distribution capabilities 1. Local 2. Shorthaul 3. Long haul 2. Railroad a. Operation 1. Organization 2. Personnel 3. Types of trains 4. Carrying capabilities b. Equipment 1. Locomotive 2. Freight cars 3. Classification yard 4. Signal block c. Financial problems 1. Shorthaul competition 2. Equipment/maintenance costs 3. Pipeline a. Requirement for use 1. Liquid commodity 2. Large source of supply and market	Kranzberg, Melvin and Carroll W. Pursell Jr. Technology in Western Civilization, Vol. I. New York: Oxford University Press, 1967, pp. 666-670.	6. "Unseen Journey." 28 minutes, 16mm color, free loan. Staff Services Gulf Research & Development Company P.O. Drawer 2038 Pittsburgh, PA 15230 7. Have groups of 4-6 students build a straight pipeline from drinking straws and experiment with different angles of descent. Then construct the same length pipeline replacing every other straw with a flex-straw. Have the students compare the second pipeline with alternating bends with the straight pipeline. 8. Have the students construct a straight pipeline with a drop of 12" and experiment with coal slurry.

# Class Meetings	Content	References	Activity
	b. Principles of flow 1. Laminar 2. Turbulent c. Pipeline system 1. Pipe 2. Valve 3. Pump 4. Right-of-way d. Contemporary techniques in pipeline utilization 1. Batching 2. Scraper method 3. Slurry 4. Capsule C. CONTAINERIZATION 1. Concept of operation a. Reduced handling b. Sealed standard unit 2. Standardized equipment a. Containers b. Alteration to modes 3. Advantages/disadvantages		

Activity V - 8

Title: "Pipelines"

Overview: The pipeline is seldom thought of when considering the major modes of freight transportation yet it accounts for about 1/3 of the gross total of all freight moved. Construction of a simple pipeline can be done in the classroom using plastic drinking straws. These straws can be fitted together by inserting a round pencil in one end and stretching it to accept the end of another straw. All "lap" joints can then be sealed using masking tape.

Have students construct a straight pipeline with a 12" drop. First have them measure the time it takes for a container of water to pass through the pipeline. This should include attempts with both a small and a large quantity of water to determine if the pressure of continuous water flow will increase the rate of speed. Next, have the students replace every other straw with a flex joint straw and construct a curved pipeline of alternating turns at various angles with a 12" drop. Again measure the time it takes for various quantities of water and compare the results with those of the straight pipeline.

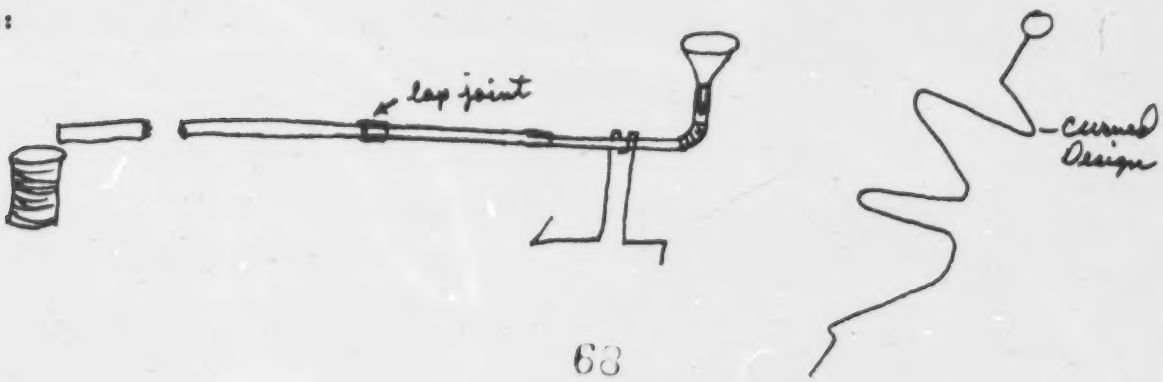
Set up a straight pipeline as described and crush a small piece of coal to granualar size (about the size of salt). Mix the coal with water (experiment with varying consistencies) and experiment with simulating a coal slurry pipeline. Catch the mixture in a container with a 5" x 5" piece of cotton cloth over the top to separate the water from the coal.

Objective: To enable the student to investigate the principles of pipeline operation, design and use.

Materials: (per pipeline)

1 - Box of plastic drinking straws
1 - Roll masking tape
1 - Box of plastic drinking straws (flex joint type)
3 - Coat hangers
1 - Small funnel
2 - Small containers (soup cans or paper cups)
1 - Small piece of coal
1 - Package of cake coloring (for coloring water)
1 - 5" x 5" piece of cotton cloth

Design:



UNIT 6

FUTURE TRENDS IN LAND TRANSPORTATION

Unit Length: 10 class meetings

The development of the Department of Transportation in 1966 was a sign of the growing concern for the state of transportation. The problems of automobile use in congested cities and the demands placed on energy reserves by individually owned and operated automobiles have brought about an interest in new alternatives. In addition, ways of making existing transportation methods more attractive have been the focus of much research.

The problems in the freight transportation industry are no less bleak. Bankruptcy and mergers in the industry are commonplace. The cost of moving goods is constantly increasing due to a variety of reasons of which energy and labor play a significant part.

The problems of contemporary transportation will be identified in this unit. Emphasis is placed on both modifying the existing state and looking at possible future solutions. Attention is also given to alterations in the transportation habits of contemporary society.

Unit Objective: To review technical, economic, environmental and social problems of land transportation and to identify possible future solutions.

# Class Meetings	Content	References	Activity
10	VI FUTURE TRENDS IN LAND TRANSPORTATION A. NATURE OF CURRENT PROBLEMS 1. Congestion a. Population density b. Urban commuters 2. Environmental impacts a. Air quality b. Land usage 3. Energy conservation a. Depletion of present reserves b. Discovery of alternatives B. TRANSPORTATION ALTERNATIVES 1. Tracked vehicles a. Equipment b. High volume capacity 2. Guideway vehicles a. Equipment b. Headway capability 3. Monorails a. Equipment b. Loop system	American Trucking Association. The Geography of Survival. (Booklet) Washington, D.C.: American Trucking Association, pp. 8-12. Hellman, Hal. Transportation in the World of the Future. New York: M. Evans and Company, Inc., 1974, pp. 7-129. Kirschner, Edwin J. "Transportation Technology: The Decade Ahead," Aviation Education. Washington, D.C.: Office of General Aviation Affairs/Federal Aviation Administration, 1969, pp. 3-13, 20-21, 24. Port, Fredrick J. "Today's Power Source for Tomorrow's Electric Vehicles," An Address before the 4th International Electric Vehicle Symposium. Philadelphia: ESB Incorporated, 1976, 33 pp. Association of American Railroads. America's Wheels. (Booklet) Washington, D.C.: Association of American Railroads, 1972, p. 15. Logan, J.S. "ACT - Ford's Automatically Controlled Transportation System," (Paper #740226). New York: Society of Automotive Engineers, 1974, 13 pp. Latvala, Einok. "The TTI Hovair PRT System," (Paper #730162). New York: Society of Automotive Engineers, 1973, 9 pp.	3. Using the mock town developed for the freight transportation unit, have the students develop a futuristic transportation system to reduce congestion, environmental impact and energy usage. 1. "Otis - DPM," 12 minutes, 16mm color, free loan. Otis Elevator Company Transportation Technology Division 11380 Smith Road P.O. Box 7293 Denver, CO 80207 2. "Sundancer," 7 minutes, 16mm color, free loan. ESB, Inc. P.O. Box 8109 Philadelphia, PA 19101 4. Using a small model airplane engine develop a wheeled vehicle to travel through a carpet tube to simulate tube flight.

# Class Meetings	Content	References	Activity
	4. Electric automobiles a. State of the art b. Limitations c. Hybrid vehicles C. INSTITUTIONAL ALTERNATIVES 1. Planned communities 2. Industrial parks 3. System integration	General Railway Signal Company. GRS Mass Transit Capabilities. (Booklet) Rochester: General Railway Signal Company, 1972, 23 pp. Boeing Company. Morgantown PRT. (Booklet) Seattle: The Boeing Company, 11 pp.	

72

73

Activity VI - 4

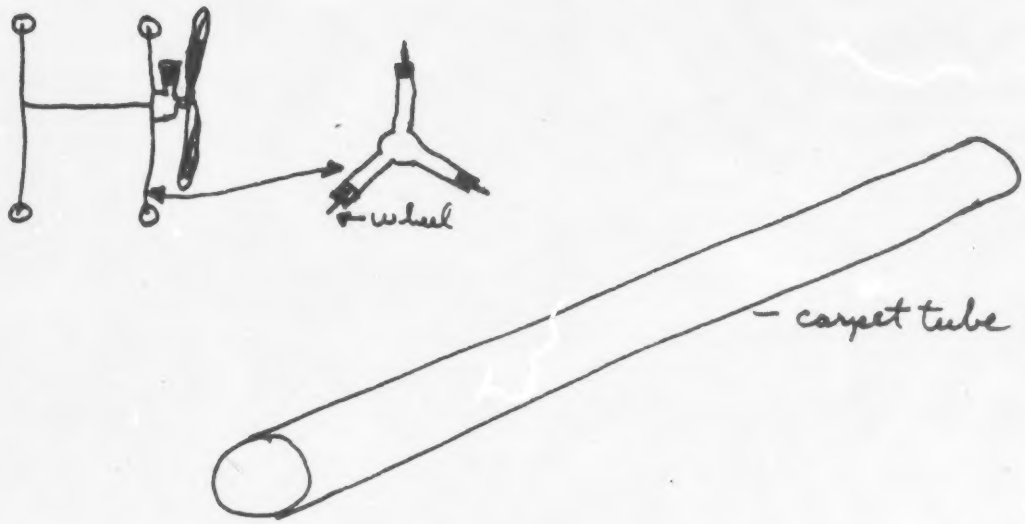
Title: "Tube Flight"

Overview: The future of transportation can be viewed as the continuation of current modes or the development of entirely new modes. Several new modes of transit have become realities with various mass transit systems designed and built within the last five years. Other futuristic modes which seem probable have yet to be developed beyond the model stage. The concept of tube flight has received a great deal of interest as a mode for high-speed long distance transportation. This activity is designed to enable the students to develop various types of body structures for the vehicle as well as experiment with inclines and sealed tubes.

Objective: To investigate the concept of tube flight and to identify the principles of its operation.

Materials:
1 - .020 model airplane engine with propeller 3 3/4"
1 - starting pack and fuel for above
6 - ½" diameter plastic wheels
2 - 4" x ½" wooden discs
1 - ½" x 3" wooden dowel
1 - 4½" x 12' carpet tube (available from carpet store)

Design:



UNIT 7

WATER TRANSPORTATION

Unit Length: 12 class meetings

The development of water transportation systems has played a vital role throughout humankinds' existence. The study of its history as well as a comprehensive understanding of the underlying scientific principles is vital in grasping this little studied area.

The impact of inland waterways is especially suited to the Mason County environment due to the proximity of the Ohio River system. Student knowledge is easily broadened by expanding the views from the towboats of the river to that of the tugboats and ocean travel.

As in most of the following units, a working understanding of the related terminology is necessary.

Unit Objective: To identify the major historical imparts of water transportation to include an awareness of the basic scientific principles, support systems and social/cultural spinoffs.

Specific Objectives:

1. To provide each student with a historical background related to water transportation.

2. To enable students to become aware of the impact of the inland water transportation system.

3. To provide each student with a working vocabulary of the terminology involved in water transportation.

4. To develop an awareness of the scientific principles utilized by all water transportation vehicles.

5. To identify the major sources of propulsion utilized by water transportation vehicles throughout history.

6. To enable students to identify the many support systems utilized by water transportation systems.

Unit 7-Water Transportation

Time Span	Content	References/Resources	Activities
3 class periods	A historical study of water transportation vehicles	Tunis, Edwin. Oars, Sails and Steam. World Publishing Co., New York, 1952. Available in PPJHS library, use with opaque projector, whole. "Water Transportation." #230-35 mm film strip available in MCMC. "The Ohio River." 16 mm film available in MCMC.	Lecture/discussion/notes
3 class periods	Scientific principles and terminology	Lewis, Edward. Ships, Time--Life. New York, 1971, (whole). "Floating and Sinking." #80787 8mm film loop, MCMC. "Bouyancy." #AS-5 transparency, MCMC.	Lecture/discussion/notes
3 class periods	Notes on inland water transportation	Big Load Afloat. The American Waterways Operators, Inc. (No longer published, copy available in water transportation software box). "Great Rivers." 16mm film, DOT U.S. Coast Guard. (See Appendix B-9).	Possible field trip to Pt. Pleasant Dry Dock (contact City Ice and Fuel, 224 1st Street)
30-54 minutes (flexible)	A review of knot tying utilized by sailing vessels and water craft.	"Knots, Hitches, Splices." Lehigh Sales and Products, Inc., Allentown, Pennsylvania 18105, (whole). Available in water transportation software box.	Overview: To familarize the student in basic rope tying skills. Tools: 20 3 foot lengths of clothesline rope (contained in water transportation box)
2 class periods	Ship construction	Edmund, Lewis. Ships. Time-Life, New York, 1971, (whole). "I Christen Thee." 16mm film, Modern Talking Pictures. (See Appendix B-6).	Boat construction

Activity VII - 4

WATER TRANSPORTATION

In developing a teaching/learning activity on water transportation, a variety of basic concepts must first be presented to the student. I feel this is best accomplished through a series of lecture/discussions, culminated with the teaching/learning activity. In this manner, the student is able to grasp the "big idea" as well as those individual contributing areas related to the topic.

The lecture/discussion series should include the following areas: a brief history of water transportation; a working terminology of the various modes, locations and types of water transportation; the basic scientific principles utilized by all water transportation vehicles; and the socio/cultural impact water transportation.

The teaching/learning activity should review and incorporate as many areas as possible reviewed in the lecture/discussion area. By utilizing a "hands-on" approach to the activity, the students are also involved in the use of basic hand tools along with their related care and safety. An explanatory view of the lecture/discussion area is as follows:

- "A brief history of water transportation."

  The historical evolution of water transportation plays a vital role in understanding its present day function. Examining mans progress as a water transporter, beginning with the log and adding components such as several lashed logs compromising a raft or a hollowed log being a canoe, the student can achieve an awareness of the evolution of the modern boat.

  Likewise, a systems approach which includes propulsion, guidance, control and support assist the student in understanding how the boat or ship functions. The evolution of propulsion would include such topics as the paddle, sail, steam, the internal combustion engine and even nuclear power. Support systems might include topics such as ports, harbors, channels and buoys, etc.

- "A working terminology of the various modes, locations and types of water transportation."

  In order for the student to fully understand how water transporters navigate, they must be aware of the appropriate terminology used in defining: the various locations of the ship (port, starboard, bow, stern, etc.); the instruments used in navigation (sextant, compass, chronometer, etc.); the various types of water transporters (hydrofoils, submarines, etc.), and their location to the water; the various modes of water

transportation (inland waterways, lakes, ocean going, etc.).

- "The basic scientific principles utilized by all water transportation vehicles."

  The student needs to become aware of a variety of scientific laws and principles of why a boat floats. An example of these principles would include the density of the fluid (ocean and fresh water) and of the boat; buoyancy and Archimedes principle, mass, displacement, volume, drag, etc.

- "The social/cultural impact of water transportation."

  This area investigates the career opportunities in water transportation as well as integrating water transportation with the various other systems of transportation namely land, air, and space. The cost per ton/mile in relationship to the other forms of transportation is also studied.

  The teaching/learning activity attempts to incorporate the above areas to insure a complete understanding of the water transporation system. By using the Industrial Arts setting as a vehicle in this activity, the students are encouraged to apply the ideas and concepts from the lecture/discussion area of the unit.

Since this unit deals specifically with water transportation, a testing tank is used to apply the learned concepts. The tank is made from an adapted rain gutter which has been sealed at both ends. Wooden supports hold the tank level and steady to support the water in the tank. A weight propulsion unit is used to propel the student fashioned boat in the tank, via a system of string, pulleys and a gravity weight.

In building the boat, the students must consider the following objective: "To design, develop, and test a boat capable of carrying at least 1½ ounces the length of the test trough in the least amount of time."

The students are permitted to use any material in making the boat, although it is recommended that wood, metal or paper be used. The design of the boat is critical if the boat is to meet the objective. Ballast is supplied by sand filled plastic "baggies." A regulation 1½ ounce weight (a fishing sinker) is used in the testing to insure standardization. Although a stop watch is recommended, a digital watch can be used with fairly accurate results.

The following materials are required for this activity:

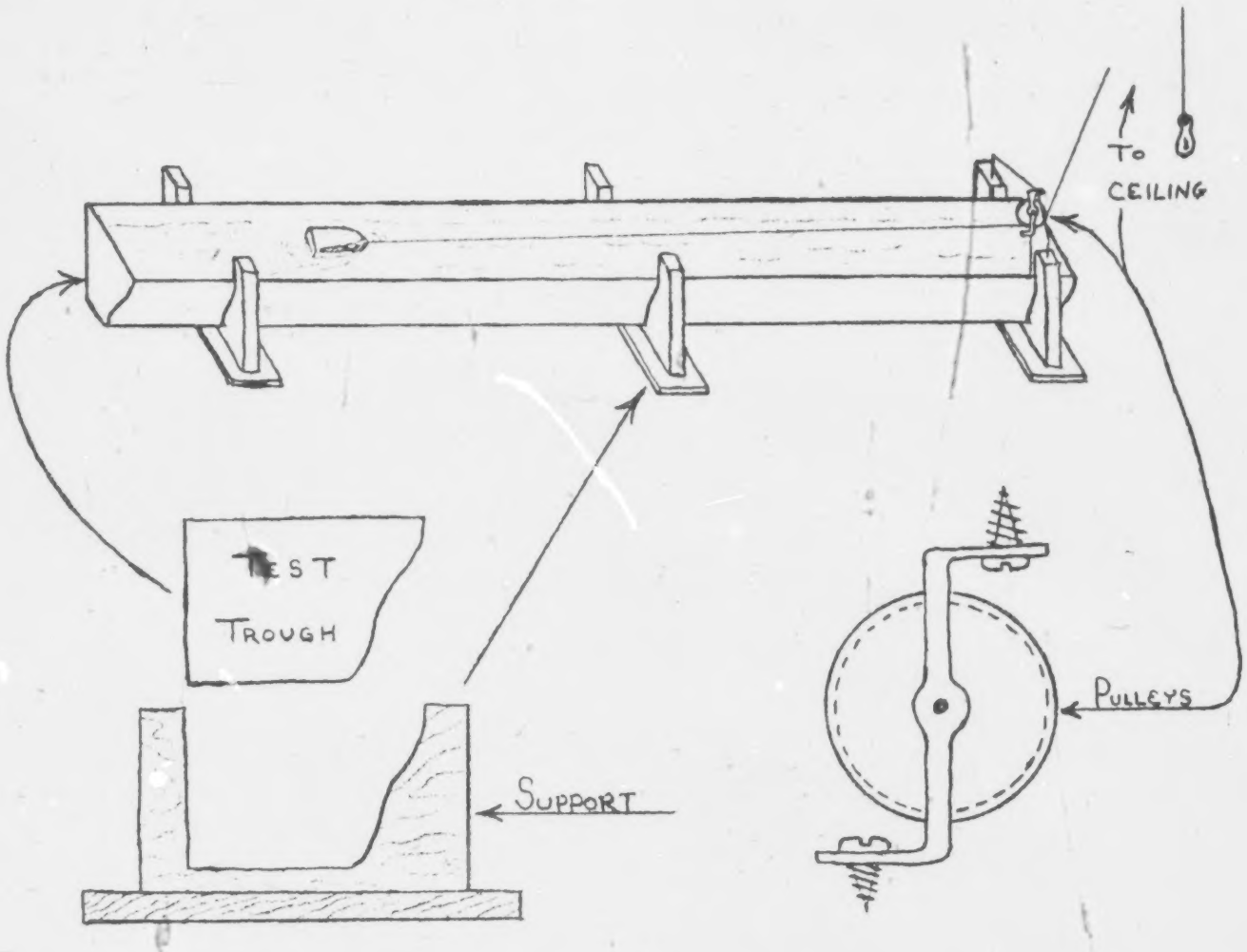
1 portable tool bin (including wood and sheet metal working tools)
1 test trough (rain gutter) sealed at both ends
2 small pulleys

25 ft. light nylon string
3 wooden supports fashioned from ½" pine
1 coat hanger for pulley support
2 sheet metal screws to anchor pulleys

Metal for the activity can be obtained from empty gallon cans supplied by the cafeteria. Poster board may be used for those students electing the paper boats, which can then be sealed with wax. (One student used a modified milk carton).

The students are graded on: the design of their vehicle; how gracefully it handles the cargo; its speed; the shape of the hull; and the overall workmanship of the vehicle.

The diagram below illustrates how the various components are used in making the test trough.



PRE-TEST/POST-TEST

WATER TRANSPORTATION

Answer the following questions either True or False.

1. The keel helps keep the boat from drifting sideways in the water. ____
2. Ballast is used to make the boat more stable in the water. ____
3. Cargo is sometimes used as ballast. ____
4. A chronometer helps the pilot measure the depth of the water. ____
5. A hydrofoil uses Bernoulli's principle to create lift. ____
6. Longitude is the line running East or West along the equator. ____
7. Archimedes principle states that a body of water is buoyed up by a force equal to the fluid displaced. ____
8. The design of a hull isn't important because water resists any moving object. ____
9. Hydrofoils actually allow a boat hull to become airborn to relieve drag. ____
10. Towboats usually pull barges while tugboats push barges. ____
11. Most of the Inland Water Transportation system is located in the eastern part of the United States. ____
12. Locks act like dams to insure enough water for navigation. ____
13. A ships rigging is the type of cargo it is carrying. ____
14. A sextant tells the pilot where true North is, rather than magnetic North. ____
15. Greenwich, where the prime meridian begins, is located in Greenland. ____

UNIT 8

AIR TRANSPORTATION

Unit Length: 35 class meetings

Since the dawn of homosapiens, man has held in reverence the flight of the bird. The first recorded attempt at flight was that of the legendary Icarus and Daedulus. From that time on, man has attempted to imitate the flight of the bird and achieve controlled flight. Less than 80 years ago, this feat was successfully demonstrated by two bicycle manufacturers from Dayton, Ohio. The rest is history.

Today air transportation provides significant impact upon our lives. Due to the rapid expansion of this technological base, humankind now has the ability to traverse the globe in a matter of hours.

The following unit is intended to provide students with an understanding of not only how these achievements came about, but to clarify how and why they work. With this base, the student should be able to comprehend and keep in touch with the rapidly expanding facets of air transportation.

Unit Objective: To provide an awareness of the scientific principles of flight as well as its related history and socio-cultural impact.

Specific Objectives:

1. To provide each student with a historical background related to air transportation.

2. To provide each student with an awareness of aviation/aerospace career opportunities.

3. To develop an awareness of the scientific principles utilized by all air transportation vehicles.

4. To enable students to become aware of how an air transportation vehicle navigates in three dimensional space.

5. To identify the many support systems utilized by air transportation vehicles.

6. To provide each student with a working vocabulary of the terminology involved in air transportation.

Unit 8-Air Transportation

Time Span	Content	References/Resources	Activities
1 class period	Introduction to Air Transportation	Teacher developed slide presentation. (Visit local airports and larger "IFR" airport(s)/control towers). 35 mm camera available from WVU TERRC.	Slide presentation/ discussion in class.
3 class periods	Introduction to Human Flight	"Human Flight-the Impossible Dream" (copies available in air transportation software box).	Class reading activity and discussion. (A Xerox copier in conjunction with the ditto master machine is an excellent method of producing multiple copies. NOTE: Be aware of the new copyright laws).
1 class period	Hot air balloons	Aviation/Aerospace Fundamentals. Jeppesen Sanderson, Inc., 1977, (whole) and Teacher's Guide. (Available in air transportation software box).	Demonstration of hot air balloons. (Available in air transportation box). Inclusion of balloon making activity was found to be too lengthy to prove the concept that hot air rises.
2 class periods	History of Heavier-than-air flight	Flight Time-Life Series (Available in PPJHS library).	Have students take notes from the blackboard on the foundational technical developments on flight.
		"History of Flight II." 16mm film NASA. (See Appendix B-7).	
		"The Flying Machine-First Cousin to the Bird," Cessna Air Age Education, pp. 2-4. (Available in air transportation box, multiple copies available).	

Time Span	Content	References/Resources	Activities
5 class periods	Aviation Career Awareness	Aviation Education. (See Appendix C-10). Packets available in air transportation software box.	Group reports prepared from Aviation Education packets. Include a brief introduction, a title page as well as guideline questions to be answered during the reports. Lecture/demonstration/ discussion.
4 class periods	Scientific principles of flight	Elmer, Lt. Colonel James D. Theory of Aircraft Flight. (Aerospace Education II) Air Force Junior R.O.T.C. Air University Maxwell Air Force Base, Alabama, 1974. Copy ordered for CEIT 9th. "Density Altitude." 16mm film, FAA. (See Appendix B-1). Fisk, Dr. Franklin G. and Dr, Milo K. Blecha. The Physical Sciences Laidlaw Brothers, 1966, (Aeronautics, pp. 502-522). Available from PPJHS Science Dept.	NOTE: A Variety of material is available in air transportation box; i.e. air has mass-gallon can crushed by condensation of water; balloon balance stick (air has weight), etc. (See your science teacher for more ideas). Build a wind funnel and airfoils.
3 class periods	The parts of an airplane	Aviation Education #GA 20-29. (Available in air transportation software box). Cessna Air Age Education. Aviation Career Awareness Program, p. 11.	Review and discussion of the major parts/control surfaces of an airplane. NOTE: Ask students to bring models of aircraft to school which can be suspended from the ceiling of the classroom.

Time Span	Content	References/Resources	Activities
6 class periods	Control surface of an airplane	Mander, Jerry, George Dippel and Howard Gossage. The Great International Paper Airplane Book. Simon and Schuster, New York, 1967. (Copy available in air transportation software box). Barnaby, Captain Ralph S. (U. S. Navy, retired). How to Make and Fly Paper Airplanes. Four Winds Press, New York. (Copy available from PPJHS library). Aviation Education. (Individual checklist for model aircraft laboratory). Available in air transportation software box). "How an Airplane Flies." 16mm film, Shell Film Library. (See Appendix B-8). Cessna Air Age Education Aviation Career Awareness Program Edwin T. Petrie, The Ohio State University, 1975. Unit III, pp. 17-26, "How Airplanes Fly." Sanderson Trainer, Control Surfaces. (Available in air transportation box). Transparency on Flight (T-47) MCMC	Paper airplane design, construction and testing. NOTE: Its advisable to secure a large room such as a gymnasium to conduct the testing portion of this activity. NOTE: These make nice Thermo-fax transparencies. NOTE: Large instructor made posters illustrating an idea or concept are excellent for class presentation. If stored properly, they may be used for a considerable time period.

Time Span	Content	References/Resources	Activities
		"Ballad in Blue." 16mm film, Champion Spark Plug Company. (See Appendix B-1).	Read
2 class periods	Aircraft construction	"The Magic of Making Airplanes," Cessna Air Age Education. (Available in air transportation software box).	Reading/discussion activity.
		"The Wind is Right." 16mm film, GAMA. (See Appendix B-1, 3).	
1 class period	General Aviation	"The General Aviation Story," 35mm slide presentation with cassette tape/dialogue, GAMA. (See Appendix B-1).	Presentation and class discussion.
4 class periods	Navigation	Cessna Air Age Education, Aviation Career Awareness Program, "Flight Planning and Navigation" Unit IV, pp. 27-32.	Map and chart reading, use of the flight plotter and computer. (Plotters and computers available in air transportation software box).
2 class periods	Rotary wing aircraft	"Helicopter Aerodynamics," Vought Helicopter Corporation.	Lecture/notes/discussion
		Boeing Vertol Company. (See Appendix C-9).	
1 class period	Summarization of Air Transportation Unit	Roy Amburger Mason County Airport	Field trip to visit an airport/airplane.
- - - - - -	Aviation glossary	Elmer, Lt. Col. James D. Theory of Aircraft Flight. (Aerospace Education II) Air Force Junior R.O.T.C. Air University	

Time Span	Content	References/Resources	Activities
		Maxwell Air Force Base, Alabama, 1974, pp. 125-133.	Lecture/discussion/notes. No time is listed here. It has proven more successful to begin each period with several aviation glossary terms prior to the day's lesson.

Activity VIII - 7

AIR TRANSPORTATION

In studying the technological impact of air transportation upon our society, a variety of areas should be investigated to give the student a full awareness of this unique form of transit. Since air transportation is relatively new (less than eight decades) a historical introduction enables the student to gain a comprehension of how the early attempts of flight were achieved. Other areas of aviation technology are also important in the students understanding of air transportation. These areas include topics such as: basic aerodynamics; power plants, instruments, and energy conversions; aeronautical meterology; and basic navigational techniques. The following outline briefly describes each of the above topics covered in the Air Transportation Unit.

I. Introduction to Air Transportation (A historical approach)

   A. Leonardo da Vinci to the Wright brothers
   B. The history of controlled, powered, heavier-than-air flight

II. Basic Aerodynamics

   A. Atmospheric Science
   B. Newton's, Bernoulli's and Charles Laws
   C. Aerodynamics of Lift, Thrust, Gravity, and Drag

III. Power Plants-Instruments and Systems

   A. Simple Machines and Energy Conversion
   B. Internal Combustion Engines
   C. Turbo and Ram Jet engines
   D. Fuel, ignition, lubrication, cooling, electrical and hydraulic systems
   E. Instrumentation and interpretation-Gyroscopic applications

IV. Aeronautical Meterology

   A. The Atmosphere-Stability and Instability
   B. Temperature, clouds and fog, pressure and moisture factors, air masses and frontal weather, wind, thunderstorms, turbulence.

V. Basic Navigation

   A. The Earth's Surface and Co-ordinates
   B. Azimuth, Direction and Distance
   C. Map and Chart interpretation
   D. Time Belts-Greenwich Standardization
   E. Radar systems
   F. Radio-telephone communication procedures

VI. Air Traffic Control

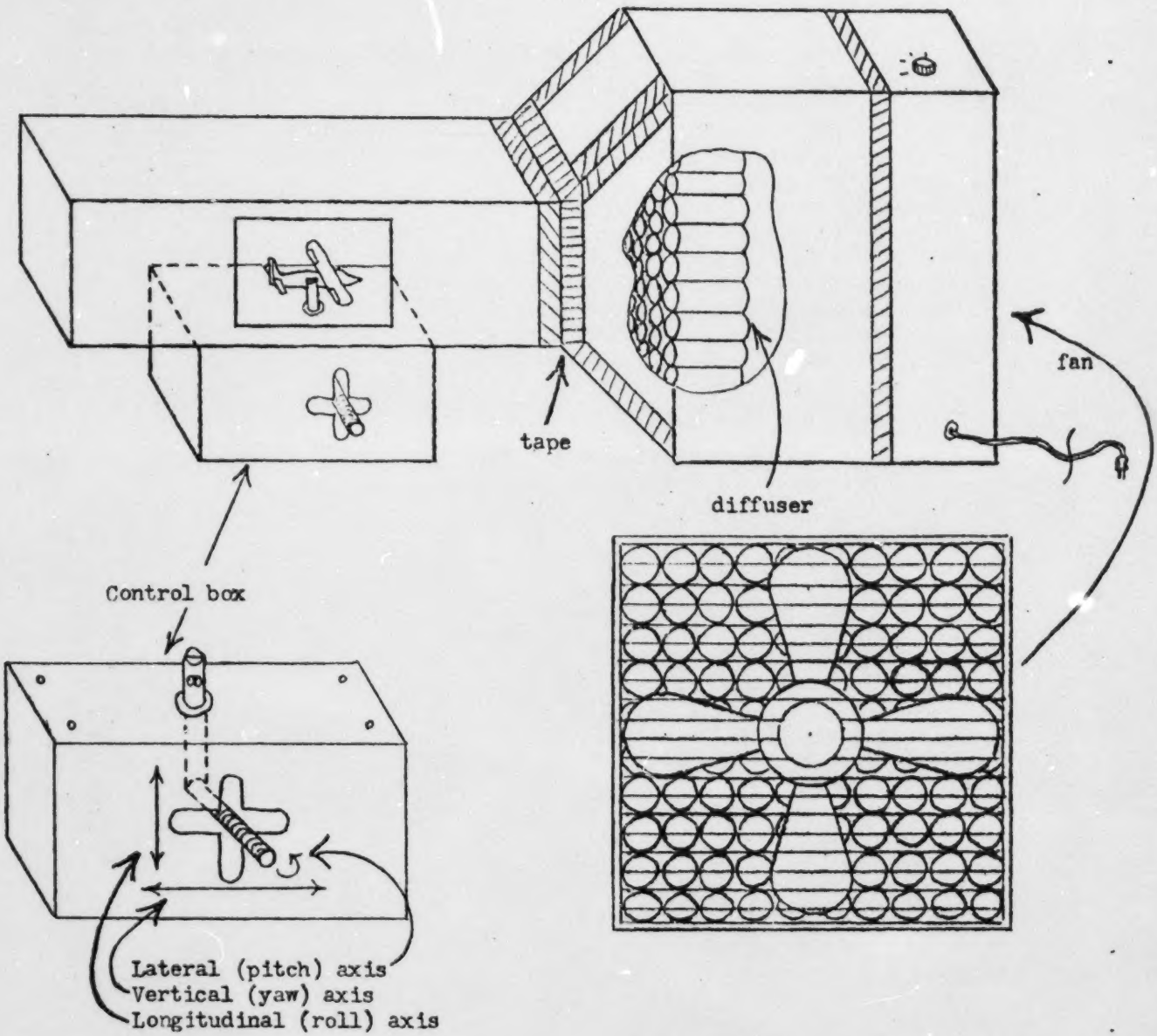
A. Federal Aviation Administration
B. Air Fraffic Control facilities

Although there are an enormous amount of activities available in this unit of study, I've delimited this "teaching/learning activity" to the Basics of Aerodynamics. In order for the student to really understand and grasp air transportation, I feel that he/she must first understand the fundamental concepts of why a plane flies. Once this base has been established, the student can more readily understand how and why the other systems interact to produce our present air transportation system.

In developing an activity on basic aerodynamics, I began with a lecture/discussion series of the fundamental laws and rules of flight, i.e. Bernoulli's Theory, Newton's Laws, etc. Once these concepts have been established, the students are able to put this knowledge into practice by experimenting with a variety of airfoil designs.

This may be achieved in several ways: (1) by having the students build and fly a variety of simple airplanes (paper and/or balsa); (2) by having the students design and build different airfoils to create lift, and (3) by having the students test the airfoils in a wind tunnel.

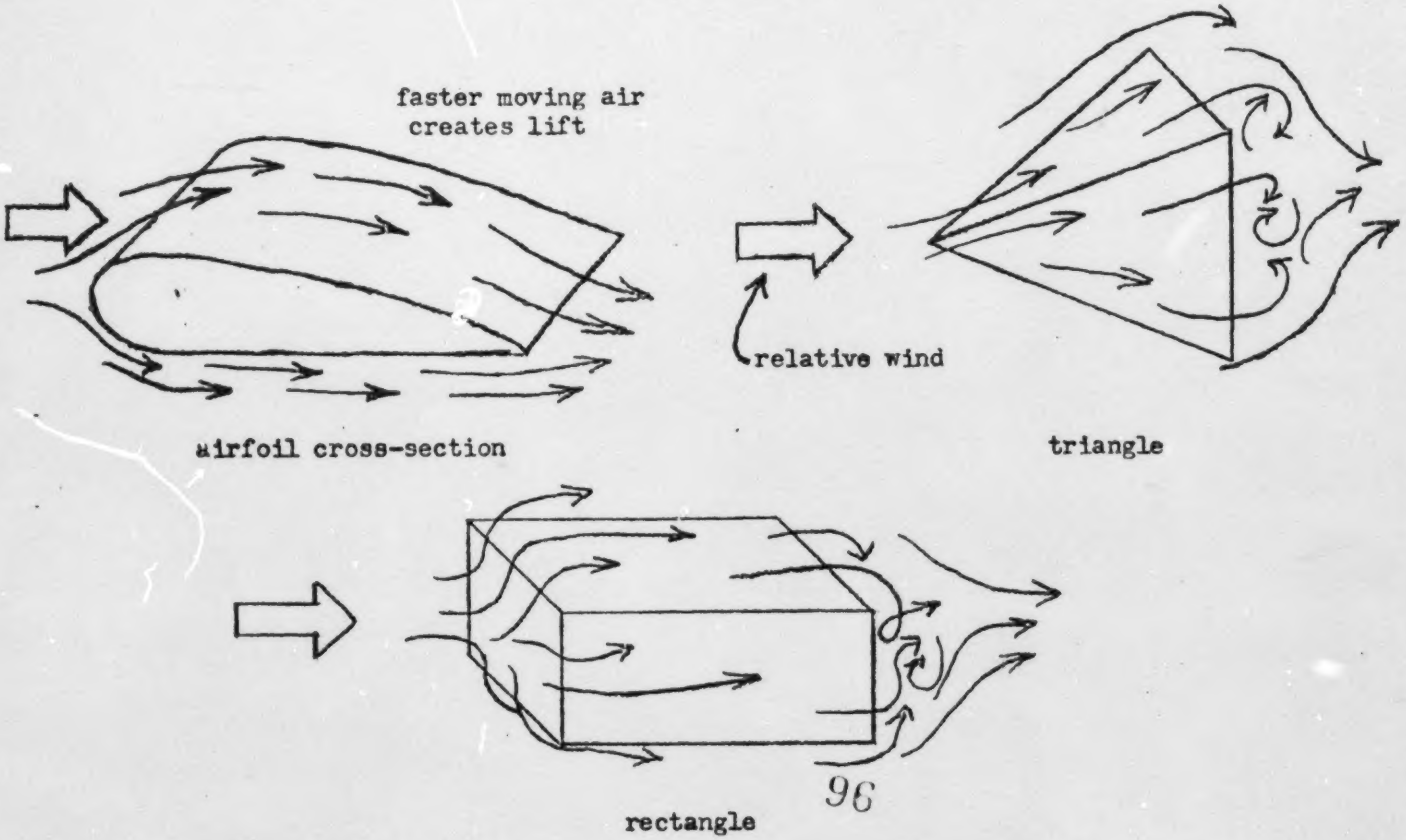
Due to limitations of financial expenditure ("less cost, more options"), cardboard was chosen as the working material for both the wind tunnel and the experimental airfoils. To control the airfoil in the wind tunnel, a control mechanism was made of wood to illustrate the concept of lateral (pitch), longitudinal (roll), and vertical (yaw) axes of a plane in flight. A sheet of clear acetate (transparency overlay) allowed the students to view their model without interrupting the air flow within the tunnel. A three speed exhaust fan supplied the required air flow in the tunnel, with selections for slow, medium, and high speed flight. The diagram on the following page shows the various components of the wind tunnel and how they were assembled.


fan
tape
diffuser
Control box
Lateral (pitch) axis
Vertical (yaw) axis
Longitudinal (roll) axis

Empty cardboard tubes were glued together to form a diffuser to straighten the turbulent air flow generated by the exhuast fan. The entire wind tunnel was designed to be disassembled for easy storage by taping the adjoining surfaces with masking tape. In this manner, the cardboard would not be ripped when disassembling the unit. The diffuser unit was also designed so that the flaps which sealed it to the tunnel could be folded back into the diffuser for easy storage. The axis control box was fastened to the tunnel with the aid of stove bolts.

A variety of airfoil designs were made by the students to demonstrate the effect of lift when placed in the tunnel. A box, a triangle and a cross-section of a wing were used to show varying amounts of left generation and turbulence. To illustrate the amount of lift created, thin paper strips were glued to the experimental airfoils to show the amount and direction of the air flow. Light-weight sewing thread was used, but did not react favorably in demonstrating airflow characteristics.

Students became knowledgeable of the terminology used in airfoil design by using a vocabulary such as: chord (the imaginary line drawn from the leading edge to the trailing edge of an airfoil); camber (the curvature of the airfoil); relative wind (the direction of the airflow past the airfoil); impact lift (Newton's Third Law of Motion); Pressure-differential lift (Bernoulli's Theory); and etc. This not only reinforced the ideas taught in the lecture/discussion unit, but gave the students a working vocabulary to use while working on their models. The diagram below shows the reaction of the paper strips on the airfoil when placed in the wind tunnel.



The wind tunnel is also useful as a testing instrument for use in the space transportation unit. Model rockets designed by the students are tested for pre-flight stability prior to their actual launch. The effects of a variety of tail fins are predicted and then tested before the model is actually launched.

The wind tunnel was designed as an on-going experimental test instrument to be used by the instructor on a year-to-year basis. Hopefully, additional activities will be generated relating to the wind tunnel and its effect on our present day air transportation system.

UNIT 9

SPACE TRANSPORTATION

Unit Length: 20 class periods

The thought of visiting distant planets and galaxies has always fascinated man. The realization of such an event occurred within the past decade. On July 16, 1969, Neil Armstrong and Edwin Aldrin became the first men to walk upon the moon, our nearest neighbor. Since then, exploratory vehicles have been launched to investigate our neighboring planets, opening a whole new dimension of exploration for humankind. New systems of launching and recovering space vehicles, like the Space Shuttle system, will permit man to reach greater depths in space travel as well as provide new and exciting accommodations for habitation and industry.

This unit is designed to provide the student with a hands-on reinforcement of the state-of-the-art in space transportation. Due to time restrictions, an expanded study of this particular system, or for that matter, of any of the systems presented in this curriculum guide, are not feasible. However, the major intent of the unit(s) is to provide an impetus so students will investigate by themselves.

Unit Objective: To provide each student with an awareness of the historical impact of space transportation as well as the underlying scientific principles and related technological spinoffs.

Specific Objectives:

1. To provide each student with a historical background related to space transportation.

2. To provide each student with an awareness of the technological spinoffs generated by the National Aeronautics and Space Administration and related agencies.

3. To develop an awareness of the scientific principles utilized by all space transportation vehicles.

4. To provide each student with an awareness of our solar system and universe.

Unit 9-Space Transportation

Time Span	Content	References/Resources	Activities
2 class periods	Introduction to Space Transportation	Aviation/Aerospace Fundamentals, Jeppesen Sanderson, Inc., 1977, pp. 14-40. NASA Tech Briefs . all. (See Appendix A-48).	Lecture/discussion/notes.
3 class periods	History of space exploration	Aviation/Aerospace Fundamentals, Jeppesen Sanderson, Inc., 1977, pp. 15-1 through 15-64. (Available in space transportation software box). "The Eagle Has Landed." 16mm film, NASA. (See Appendix B-7).	Lecture/discussion/notes. NOTE: Additional information too lengthy for chalkboard. Notes may be typed and duplicated for inclusion in the student's notebook.
1 class period	The Space Shuttle	Space Shuttle. National Aeronautics and Space Administration (whole). Available from: Lyndon B. Johnson Space Center, Houston, Texas, February, 1975. (Copy ordered).	Lecture/discussion/notes.
2 class periods	Principles of Rocket Flight	Walker, John R. Exploring Power Technology. Goodheart Wilcox Co, Publishers, 1976, pp. 151-160. Estes Industries. (See Appendix C-31). "Dr. Goddard to Apollo 17-Stepping Stones in Space." A-70, 16mm film, MCMC. (See Appendix B-7).	

Time Span	Content	References/Resources	Activities
		"The Gyroscope Through the Ages" Sperry Flight Systems. (See Appendix C-55). Available in space software box. Rocket Engines (1610, EE-6), Transparency, MCMC.	NOTE: An interesting activity demonstrating gyroscopic action is to attach wooden dowels to the axle of a bicycle wheel. By seating a student in a revolving chair and spinning the rim, gyroscopic control can be easily understood especially when used with NASA film, "The Dream That Wouldn"t Come Down." HQK-125-1965.
10 class periods	Rocket construction and flight	Mitchell, Charles W. and Joseph Piley. A Guide to Building Homemade Rockets. West Virginia University, Morgantown, West Virginia. (Copy available in space transportation software box and from Technology Education TERRC). See Appendix A-1.	Individual student design, construction and testing of model rockets.
2 class periods	The solar system	"Our Solar System." 16mm film, NASA. (See Appendix B-7). Friedman, Herbert. "The Amazing Universe," National Geographic Society, 1975. (Available in PPJHS library). "Solar System" (EA-5) transparencies, MCMC.	Lecture/discussion/notes

UNIT 10

TRANSPORTATION SYSTEMS

Unit Length: 10 class meetings

In the United States there exists a major problem with the integration of the various transportation modes. Past history has to some extent brought about this problem. In earlier times the railroads were not permitted to own inland waterway transport companies or trucking companies. This was done in part to avoid a monopoly and also to keep the buying company from destroying its new acquisition to eliminate competition.

As the various freight and public transportation modes developed over the years, the competition grew also. Today it is the rule more than the exception to find a railway depot in one area of a city, a bus terminal in another and an airport in a third with no link for high volume transportation between the three. The same applies to freight transportation; however, in recent years this has become less of a problem due to containerization.

In this unit the nature of present transportation "network" is studied and ways in which it could become more of a transportation "system" will be identified. The key capability functions of each of the modes will be reviewed to aid in determining the best system approach for transportation.

Unit Objective: To investigate the principles of a true transportation system and to identify ways in which the present network could be changed to a system.

# Class Meetings	Content	References	Activity
10	X. Transporation Systems A. CURRENT NETWORK PROBLEMS 1. Competition between modes 2. Disjointedness of terminal facilities B. SYSTEMS APPROACH 1. Identification of service needs a. Passenger 1. Intercity/state 2. Intracity b. Freight 1. Distance a. long haul b. local distribution 2. Commodity a. Bulk b. Manufactured 2. Determining unique features of modes a. Movement capability b. Speed c. Capacity d. Cost of operation	Benson, Albin. Transportation - A Better Way to Go. Melbourne: Florida Institute of Technology Press, 1969. Danforth, Paul. Transportation. New York: Doubleday and Company, Inc., 1965, pp. 129-138.	1. "Transportation: Projection 70", 24 minutes, 16mm color, free loan. Technology Education Research and Resource Center Technology Education Program West Virginia University Morgantown, WV 26506 2. Divide the students into groups of 3-4 and have them collectively develop a transportation system (on paper or by models) for an entire state. They should preferably select a state that is able to utilize land, water and air transportation. Assign each group to one mode or modes if number of groups is small. Have one group take responsibility for overall coordination of the planning.

# Class Meetings	Content	References	Activity
	C. TRANSPORTATION SYSTEM 1. Intermodal passenger terminals 2. Intermodal freight terminals 3. System coordination		

ELECTIVE UNITS

The Metric System

The Metric System, formally titled the "International System of Measurement Units" (SI) is being used increasingly more in the United States. The antiquated Imperial system of measurement presently used in the U.S. is finally giving way to this world recognized measurement system. In order to make this change, a series of legislative bills have been proposed in Congress to make a gradual switch to the metric system over a ten year period. Several industrial firms have already begun to make this change. The IBM Corporation is presently incorporating a ten-year transition program to prepare their workers for the coming change. They've already made the switch with engineering dealings outside of the country.

The automotive industry is also making a gradual change to the metric system. Automotive spark plugs always have been metric and soon the entire vehicle will adapt to this easier form of measurement. Think how much easier it will be to select the proper socket or wrench simply by choosing a size larger or smaller instead of memorizing the conventional fractional scale.

Several states are also beginning to familiarize motorists with this coming change by posting distances and speeds in metric alongside the customary system. The food industry is beginning to print the metric equivalent weight on the container. The Pepsi-Cola Company has gone one step further by distributing their containers in liters and then giving the Imperial equivalent! Likewise, medical and pharmaceutical industries have always used the metric system and will only need to drop the customary equivalent from their label.

What does this have to do with us as educators? By beginning the transition at an early age, the students will become familiar with the conversion units and knowledgeable of the function of the metric system. Since the transition period will be the most difficult time for the American public, an early awareness to this change will facilitate that change. Students entering the metric system after the transition period will be able to adapt easily to the metric system since it will have by then become the major system of measurement, i.e.-there will be no need to convert from metric to English.

In developing a teaching/learning activity focused on the metric system and its conversion, I have designed a series of learning stations to include length, mass and volume measurements. The student objective states that: "Each student will become familiar with the conversion and function of the metric system and be able to answer at least 70% of the questions on a written post-test." Prior to the activity, the students become familiar with the metric system via a lecture/discussion series. This series includes: (1) a history of the Imperial and the Metric system (multiples, submultiples and decimals; (2) work sheets to rein-

force the students knowledge of the Metric system and its conversions; and, (3) a collage consisting of metric labels brought in by the students.

The following charts to aid the student in their conversions are placed in the room and distributed to the students for their notebooks.

METRIC PREFIXES

Prefix	Increase or decrease	
kilo-	1,000	One thousand
hecto-	100	One hundred
deka-	10	Ten
metric unit	-	Meters, liters, grams, etc.
deci-	0.1	One-tenth
centi-	0.01	One-hundredth
milli-	0.001	One-thousandth
micro-	.00001	One-millionth

METRIC UNITS

gram - the metric unit for mass (weight), comparable to our ounce

Celsius - the metric unit for temperature, comparable to our Fahrenheit

meter - the metric unit for length, comparable to our yard

liter - the metric unit for liquid, volume, comparable to our quart

APPROXIMATE CONVERSION TABLE

When you know:	Multiply by:	To find:
	(Length)	
inches	2.54	centimeters (cm)
feet	30	centimeters (cm)
yards	.9	meters (m)
miles	1.6	kilometers (km)
meters	39.37	inches (in.)
	(Area)	
sq. inches	6.5	sq. centimeters (cm^2)
sq. feet	0.09	sq. meters (m^2)
sq. yards	0.8	sq. meters (m^2)
sq. miles	2.6	sq. kilometers (km^2)
acres	0.4	hectacres (ha)
	(Mass)	
ounces	28	grams
pounds	454	grams
short tons (2000 lbs.)	907	kilograms
	(Volume)	
teaspooons	5	milliliters (ml)
tablespoons	15	milliliters (ml)
fluid ounces	30	milliliters (ml)
cups	0.24	liters (l)
pints	0.047	liters (l)
quarts	0.95	liters (l)
gallons	3.8	liters (l)

The teaching/learning activity is divided into three major areas: length, volume, and weight. The students are evenly divided into three groups and report to their assigned numbered station. The groups periodically change stations in order to allow everyone to complete the three station activity. Each station contains a variety of activities for the students, as well as the related equipment for completing the activity. The students are each given an answer sheet which requires the response to be given in the English and the Metric system. The instructional sheet at each station gives the required calculations for the students. These instructional sheets are covered with a clear acetate covering prior to being taped to the desk near the station. This prevents sheets from being soiled and/or wrinkled, and provides a central location available to all the studens of the group. The activities are as follows:

Resources:

U.S. Moving Inch by 2.54 cm to Metric System. Michele Williams, Mainliner Magazine, 1973.

Metric System-Weights and Measures.. Reprinted from the World Book Encyclopedia, 1976.

STATION #I

LENGTH MEASUREMENTS

This station should include the following equipment:

2 English/metric rulers
2 English/metric meter sticks
2 English/metric tape rules

On your answer sheet, measure and record in English and metric, the length of the following:

1) The height of this table is ____ centimeters, ____ millimeters and ____ inches.

2) Measure the radius of one of the wheels to the mouse-trap car. ____millimeters ____ inches

3) How tall are you in ____ centimeters; in inches ____.

4) The perimeter of the window is ____ centimeters and ____ inches. (Perimeter is the distance around)

5) The length of my desk is ____ centimeters, ____millimeters, ____ inches and ____ feet.

6) The width of the C.E.I.T. boy's nose is ____ inches, ____ feet, ____ millimeters and ____ centimeters.

7) The length of your foot is ____ centimeters and ____ inches.

8) Measure the length of a floor tile. ____ centimeters, ____ millimeters, ____ inches.

9) Measure the perimeter of this room. ____ meters, ____ yards

10) Find something on your body (a finger, an arm, a fingernail, etc.) which is close to: an inch ____; a millimeter ____; a centimeter ____; an foot____.

STATION #II

WEIGHT MEASUREMENTS

This station should include the following materials/equipment:

1 gram scale
1 bathroom scale
4 ½" flat washer
3 8 penny nails
1 pair of scissors
4 paper clips
1 juice can (12 ounce, full)
1 candle

On your answer sheet, measure and record in English and metric, the weight of the following:

1) The weight of four washers is ____ grams.

2) The weight of one candle is ____ grams.

3) The weight of one nail is ____ grams.

4) The weight of the scissors is ____ grams.

5) The weight of a quarter (25¢) is ____ grams.

6) The weight of two paper clips is ____ grams.

7) The weight of an eraser (blackboard) is ____ grams.

8) Your body weight is ____ pounds, ____ grams and ____ kilograms. (Remember, 454 grams is 1 pound)

9) The weight of two dictionaries is ____ grams and ____ kilograms.

10) The weight of a 12 ounce juice can is ____ grams.

STATION #III

VOLUME MEASUREMENTS

This station should include the following equipment:

1 graduated 100 milliliter cylinder (plastic)
2 gallon cans
1 measuring cup
1 quart jar
1 12 ounce can (empty)
1 sponge (for clean-up)

On your answer sheet, measure and record in English and metric, the volume of the following:

1) One milliliter is ____ liters.

2) One liter is ____ milliliters.

3) Which is larger, one quart or one liter? How much?

4) Will 500 milliliters fit into the quart jar: Why? Why not?

5) How many liters are in a gallon? (Note-1 liter is 1.06 quarts)

6) How many milliliters will fit into a 12 ounce can? ____

7) How many milliliters are in a measuring cup? ____

8) How many milliliters are in 20 ounces? ____, in 16 ounces____

9) How many ounces are in 100 milliliters? ____, in 40 Milliliters____

10) How many milliliters are in a liter? ____, in a centiliter? ____

PRE-TEST / POST-TEST

METRIC MEASUREMENT

1. The prefix milli means _____.

2. The length of a 6 inch screw-driver is about _____ centimeters.

3. The unit for measuring weight in the metric system is the _____; for volume _____; for length _____.

Which unit would you use to find:

4. the length of a city block? (meters or kilometers) _____.

5. the distance between Pt. Pleasant and Charleston? (meters or kilometers) _____.

6. Water boils at _____°Celsius and freezes at _____ °Celsius.

7. The prefix kilo means _____. Therefore 5 kilometers is how many meters? _____.

8. The thickness of a penny is about _____ millimeters.

9. One thousands grams equals one _____. (centi, deci, kilo-grams)

10. A quart of milk contains about _____ liters.

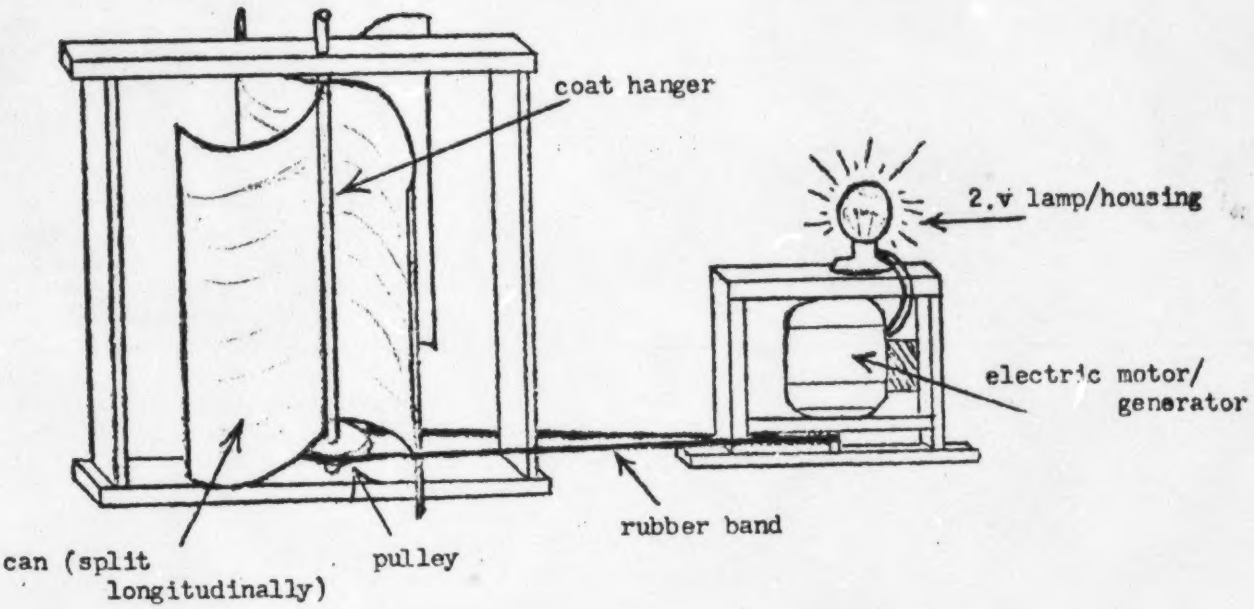
ALTERNATIVE ENERGY SOURCES

The need for bigger and better energy systems in the United States is becoming increasingly important to the well being of its citizens. President Carter has recently illustrated this need in a series of energy information sessions directed toward the American public. In these sessions, he has proposed a variety of energy conservation steps as well as a plan of research and development on alternative energy sources to aid our rapidly depreciating supply of natural energy. One plan supported by the President and Congress is to give more financial support to the Energy Research and Development Administration. E.R.D.A. is presently expanding their programs to include categories involved in: (1) the conservation of energy to efficiently make use of the present energy sources, which includes the development of alternate fuels and engines for automobiles and reduce their dependence on petroleum sources; (2) fossil energy to expand the present coal production rate and develop new systems in coal gasification and liquid fuels; (3) alternative energy forms to include solar, geothermal, wind and advanced energy systems; (4) nuclear energy for use in medical, industrial and research applications and designing better systems for the generation of electricity; (5) the environment and safety to investigate the health, safety, and environmental effects of the development of energy technologies, and (6) national security systems to supervise the production and administration of nuclear materials for both civilian and military needs.[1]

How does this relate to a curriculum in Transportation Technology? The major thrust of any transportation system relies heavily upon its propulsion system. The propulsion system, whether it be electrical, combustible, nuclear or other, requires an expendable energy source to propel the vehicle. This energy source must be periodically recharged or refueled if the propulsion unit is to continue to function. The only exception to this rule would be those units which directly convert useable energy such as the suns rays, to electricity. Even this system requires periodic maintenance, which in turn requires energy sources, either conventional or alternate. In fact every transportation system, regardless of the propulsion system, requires a proportional amount of time in support (maintenance) facilities.

Our whole technological base relies on an efficient, dependable energy system. Beginning with the Industrial Revolution, mankind has depended almost entirely upon a useable energy source. The present 'conventional' energy sources are being rapidly depleated. In

[1]William W. Eaton. Geothermal Energy. The Energy and Development Administration.


coat hanger
2.v lamp/housing
electric motor/
generator
rubber band
can (split
longitudinally)
pulley

order to supplement these vital sources, alternative energy systems must be established.

This teaching/learning activity is directed toward that purpose: "To design, develop and test an alternate energy form capable of generating sufficient electricity to illuminate a 2 volt light bulb."

Alternate energy sources are divided into several major categories. I've defined these as follows:

I. Solar energy-The energy which can be collected from the sun's radiation.
   A. Chemical-photosynthesis
   B. Electrical-silicon solar batteries
   C. Thermal-heat from the sun

II. Water-Energy developed by water wheels and turbines, powered by the hydrologic cycle.

III. Biofuels-Renewable energy sources from living things.
   A. Methane production-energy gained from the decomposition of organic material.
   B. Wood-energy from using wood as a fuel

IV. Wind-Energy gained from the sun alternately heating and cooling the atmosphere, creating high and low pressure zones, and thereby creating winds.

This activity has been limited to the use of one alternative energy source; the wind. The energy created by the wind can be converted to mechanical power and used immediately or saved through an energy storage system such as electrical storage batteries, flywheels, electrolysis (the chemical process of breaking down salt water to form combustible hydrogen), or compressed air/water.

Two types of wind power plants are illustrated.

A. The Savonius Windmill-These windmills originated in Persia (now Iran) around the 10th century. This windmill uses a vertical axis to generate power.

Materials Needed:

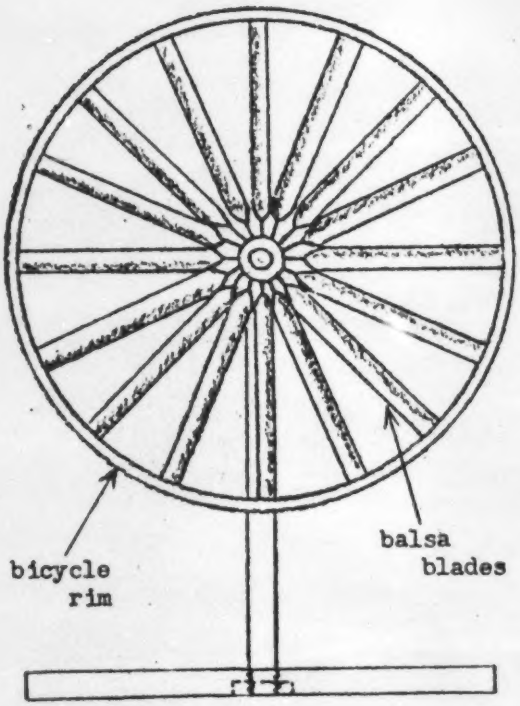
- 2 - 32 ounce cans
- 1 - coat hanger
- 1 - 2 volt lamp/housing
- 1 - small electrical motor/generator
- 1 - large rubber band
- 1 - 6' length, ¼" pine board
- 1 - 2" pulley, 1/8" hole

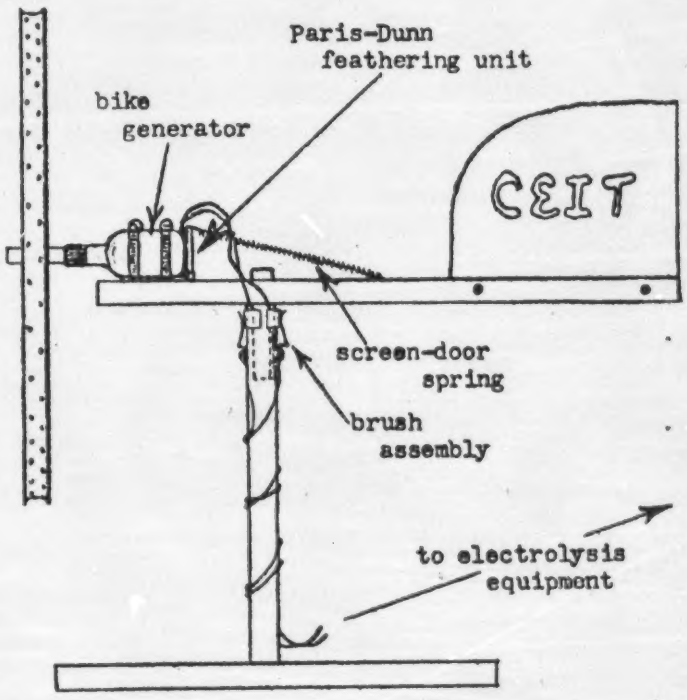
B. The bicycle-wheel windmill is an innovative class project, especially suited for the junior high school level. The wheel is de-spoked except for six support spokes to hold the rim to the hub. Balsa wood blades, set at an angle of approximately 10° from level, use the force of the wind to generate power. A bicycle generator is mounted transversally to the wheel and is connected to rotatable tail section. Since this is an introductory project, a simple feathering device of the Paris-Dunn type is used. As the wind speed increases, the spring tension is over-come, allowing the wheel to rotate back with the wind (Energy Primer, Portola Institute, 1974, p. 87).

The electricity generated is then used to produce hydrogen through the process of electrolysis in salt water. (Most science teachers have this equipment). Due to the dangers of storing and compressing this volatile gas on a large basis (for automotive engines), a balloon storage system is used to run a model steam car.

Materials Required:

1 - 26" bicycle rim and hub
1 - 20" x 15" x 3/4" pine board
1 - 10" x 10" x 1/8" sheet plywood
1 - 4" door hinge
1 - 6" screen door spring
16 - 1½" x 25" balsa strips
1 - bicycle generator
1 - 15", 3/4" pipe (threaded on end)
1 - 6" solid 11/16" brass rod
3 - feet #14 stranded plastic covered wire
2 - ¼" bolts, nuts and lock washers
1 - 1" x 2" x 1/16" sheet copper (brushes)
2 - 6" pipe clamps





PRE-TEST / POST-TEST

ALTERNATIVE ENERGY SOURCES

Answer the following questions either True or False

1. Geothermic (geo = land; thermic = temperature) energy is the energy gained from the natural heat of the earth. ____

2. The hydrologic cycle is actually the amount of hydrogen in the atmosphere. ____

3. The abbreviation E.R.D.A. stands for the "Environmental Risk and Destruction Agency." ____

4. Electrolysis is the process of sending electrical current through salt water to produce hydrogen. ____

5. Methane gas would be classified under "wind power." ____

6. The windmill is a power plant that coverts the energy of the wind into mechanical energy. ____

7. Storage batteries allow man to save energy by converting mechanical energy to electrical energy. ____

8. A governor is used on a windmill to allow it to turn as rapidly as possible. ____

9. The "Savonious windmill" was originated in England about 1492. ____

10. Because they are relatively new, windmills are usually practical only in remote due to their high expense at purchase. ____

FILM LIST

West Virginia University MORGANTOWN, WEST VIRGINIA 26506

College of Human Resources and Education
Technology Education Program

Dear Sir or Madam:

In conjunction with West Virginia University, I am working on a special project at Point Pleasant Junior High School. This project involves the development and implementation of a new curriculum in technology education.

I would like to obtain the following free loan materials for use in my classroom. If these materials are not available on the preferred date as indicated, please schedule for the nearest open date.

Code #	Request Date	Title

Please send these materials to: CEIT Project - 9th Grade
Point Pleasant Junior High
Ohio River Road
Point Pleasant, WV 25550

Thank you for your cooperation in making these materials available for use to schools.

Yours truly,

Film List: All films cited are on a free loan basis requiring return postage.

1. Film Section-Department M
Champion Spark Plug Company
P. O. Box 910
Toledo, Ohio 43661

"Ballad in Blue." 16mm, color, 14½ minutes. Excellent introduction to 3-axis flight.

"The Wind is Right." 16mm, color, 27½ minutes. High school fabrication of an aircraft.

"Density Altitude." 16mm, color, 27½ minutes. Good for aircraft navigation control.

"The General Aviation Story." 35mm slide cassette tape with dialogue. General overview to general aviation.

2. ERDA Film Library
P. O. Box 62
Oak Ridge, Tennessee 37830

"Challenge of the Future." 16mm, color, 27½ minutes (0508). Keeping up with energy requirements.

"Energy-The American Experience." 16mm, color, 27½ minutes (0507). America's energy requirements.

"Preparing for Tomorrows World." 16mm, color, 28 minutes (0451). Possible alternative energy sources.

3. F.A.A. Film Library AC-912
Post Office Box 25082
Oklahoma City, Oklahoma 73125

"The Wind is Right." (See Champion Spark Plug Co. #1).

"Flying Floats." 16mm, color, 17½ minutes. Transition to air transportation.

4. General Motors Corporation
Public Relations Staff-Film Library
General Motors Building
Detroit, Michigan 48202

"ABC's of the Diesel Engine." 16mm, color, 14½ minutes. Diesel engine operation.

"ABC's of the Gas Turbine." 16mm, color, 14½ minutes. Gas turbine operation.

"ABC's of the Automobile Engine." 16mm, color, 24½ minutes. Excellent introduction to the components and systems of an internal combustion engine.

5. Mason County Materials Center
Point Pleasant High School
2312 Jackson Avenue
675-4226
Ms. Van Horn-Coordinator

Slide strips-"Water Transportation" (#230), 35mm.
Historical approach to water transportation.

8mm Loop-"Floating and Sinking" (projector available MCMC)
Demonstration of Archimedes principle.

16mm Films-"Dr. Goddard to Apollo 17." 24½ minutes, b/w.
Overview of NASA's space program.

Transparencies-"Buoyancy" (AS-5), Archimedes principle
"Flight" (T-47), Axes of flight
"Engines" (1610, EE-2), Two-stroke engine
(1610, EE-3), Four-stroke engine
(1610, EE-4), Diesel engine
(1610, EE-6), Rocket engine
"Electricity" (ME-1 through 9), Fundamentals of magnetism and electrical generation.
"Solar System" (EA-5), Our Solar System and Universe
"Atomic Energy" (AE-1 through 6), Atomic theory

6. Modern Talking Picture Service
Film Scheduling Center
2323 New Hyde Park Road
New Hyde Park, New York 11040

"I Christen Thee." 16mm, color, 27½ minutes. Ship construction.

"LNG On It's Way." 16mm color, 24½ minutes. Newport News Construction Company fabrication of a modern ship.

7. NASA Langley Research Center
Langley Station
Public Affairs Office
Mail Stop 154
Hampton, Virginia 23665

"The Eagle Has Landed." (HQ 194-1969), 16mm, color, 27½ minutes. Man's first landing on the moon.

"The Dream That Wouldn't Come Down." (HQa 125-1965), 16mm, b/w, 27½ minutes. Dr. Goddard's research in early rocketry. Especially good for gyroscopic control.

"A Man's Reach Should Exceed His Grasp." (HQa 219-1972), 16mm, color, 29½ minutes. Excellent introduction/summary to air/space transportation.

"Our Solar System." (HQ 234-1973), 16mm, color, 14½ minutes. Our solar system/universe.

"History of Flight, Part II." (FAN-106), 16mm, color, 28 minutes. The Wright Brothers.

8. Shell Film Library
1433 Sadlier Circle W. Drive
Indianapolis, Indiana 46239

"How An Airplane Flies." 2 reels, 16mm, color, 56 minutes total. Excellent introduction/conclusion to the theory of flight.

"Acting in Turn." 16mm, color, 19 minutes. Excellent introduction to simple machines and

energy conversions.

"High Speed Flight." 16mm, color, 20 minutes. Super sonic flight.

9. Department of Transportation
United States Coast Guard
Commander (dpn)
2nd Coast Guard District
1430 Olive Street
St. Louis, Missouri 63103

"Story of the Great Rivers." 16mm, color, 28 minutes. Inland water transportation.

A-V Material Guide

Title _____

Area of content: _____ Communication _____ Transportation

_____ Production _____ Other _____

Summary Statement: _____

_____

_____

Appropriate grade level: _____ elementary grade(s)

_____ junior high schoolgrade(s)

_____ senior high school grade(s)

Source of media: _____

_____

_____

_____

Type of media: _____ 16 mm film _____ slide series _____ filmstrip

_____ Other _____

Sound source: _____ on film _____ cassette tape _____ record

_____ none

Length: _____ minutes Cost: _____ rental fee _____ purchase price

Comments: _____

_____

_____

_____

_____

FREE AND INEXPENSIVE MATERIALS

West Virginia University | MORGANTOWN, WEST VIRGINIA 26506

College of Human Resources and Education
Technology Education Program

Technology Teacher Center
2925 University Avenue

Dear Sir:

I am a Doctoral student at West Virginia University working on a Junior High School curriculum project in the area of transportation. I am currently developing sections on land, water, and air transportation. The curriculum project objective is to acquaint the student with the function and mechanics of our various types of transportation systems.

I am writing you in an effort to obtain maps, graphs, transparencies, booklets, charts, and other types of material which I would use in the classroom. I would also greatly appreciate information on any free loan film which you have available and feel would be useful to the project.

Thank you.

Yours truly,

REK/cjk

Addresses of free and inexpensive materials to accompany this curriculum. It is recommended that the instructor implementing this course of study investigate the practically unlimited potential available by writing to the following firms. Several example form letters are included in this appendix to aid the instructor.

(Listed alphabetically)

1. Aeropatiale Helicopter Corporation
   1710 W. Marshall Drive
   Grand Prairie, Texas 75050

   8½" x 11" glossies
   Book on aerodynamics

2. Aerospace Industries Association of America, Inc.
   1725 De Sales Street, N.W.
   Washington, D. C. 20036

   Journal of Aerospace Education
   Aviation Education
   Aerospace Education Directory

3. Air Transport Assocation
   1709 New York Avenue
   Washington, D. C. 20006

   Film and publication list

4. American Gas Association
   1515 Wilson Boulevard
   Arlington, Virginia 22209

5. American Petroleum Institute
   2101 L Street
   Washington, D. C. 20037

   Numerous publications on petroleum

6. Aviation Distributors and Manufacturers Assoc.
   1900 Arch Street
   Philadelphia, Pennsylvania 19103

   Educational materials directory
   "The Wind is Right." film
   "How to Develop an Air Youth Day"

7. Ballanca Aircraft Corporation
Alexandria
Minnesota 56308

"The General Aviation Story"
Assorted posters and educational media

8. Beech Aircraft Corporation
Wichita
Kansas 67201

Genology chart (1930-1976)
Large assortment of general aviation information
The Great Beechcraft Adventure Kit
(non-ed.)

9. Bendix Electrical Components Division
Sidney
New York 13838

Wall charts
ABC's of Bendix Ignition
The Aircraft Magnet

10. Boeing Vertol Company
Philadelphia
Pennsylvania 19142

Glossies on Boeing helicopters
Light rail vehicle information

11. Cessna Aircraft Company
Air Age Education Department
P. O. Box 1521
Wichita, Kansas 67201

Instrument panel posters
8½" x 11" pictures of Cessna line
Meteorology chart
Cessna Air Age Education Program

12. Centuri Engineering Company
P. O. Box 1988
Phoenix, Arizona 85001

Catalog on model aircraft

13. C & D Batteries Division
3043 Walton Road
Plymouth Meeting, Pa. 19462

Facts about storage batteries
Chart-Parts and assembly of a battery
Chart-How a storage battery works

14. Champion Spark Plug Company
P. O. Box 910
Toledo, Ohio 43661

Film list
Special request for tech. info.

15. Consolidation Coal Company
Public Relations Department
407 Monogahela Building
Morgantown, W. Va. 26505

Consolidation Coal Company
Oliver Plaza
Pittsburgh, Pa. 15222

Information of energy sources

16. Delco-Remy
Division of General Motors
P. O. Box 2439
Anderson, Indiana 46011

High energy ignition systems
Delco-Remy Training aids and price list

17. Delta Airlines, Inc.
Hartsfield Atlanta International Airport
Atlanta, Georgia 30320

Information on airlines

18. Department of the Air Force
Headquarters Air Force Eastern Test Range (AFSC)
Patrick Air Force Base
Florida 32925
c/o Arthur B. Hacks
Community Relations Office
Office of Information

A wide variety of educational materials available upon request

19. Department of Finance and Administration
Fuel and Energy Office
1262½ Green Street
Charleston, W. Va. 25311

Miscellaneous handouts on energy

20. Department of Transportation
National Highway Traffic Safety Administration
Washington, D. C. 20590

Film/audio-visual catalog

21. Department of Transportation
U. S. Coast Guard
Washington, D. C. 20590

Wide variety of educational material available on water transportation

22. Department of Transportation
Federal Aviation Administration
Washington, D. C. 20591

Miscellaneous information on air transportation

23. Department of the Air Force
Air Force Reserve Officers
Training Corps (AV)
Maxwell Air Force Base
Alabama 36112

Theory of Aircraft Flight
Space Technology
Aerospace Community
Aircraft of Today

24. Department of Airports
No. 1 World Way
Los Angeles, Calif. 90009

Large variety of information on airports

25. Department of Transportation
Urban Mass Transportation Administration
Washington, D. C. 20950

Information on light rail vehicles
8½" x 11" glossies of light rail
Federal Register, Part I & II

26. Department of Transportation
Office of the Secretary
Washington, D. C. 20590

Information on D.O.T.
Information on aviation
The National Highway Traffic Safety Administration

27. Dynaship Corporation
81 Encina Avenue
Palo Alto, California 94301

Information on modern wind powered ships

28. Eastern Air Lines, Inc.
10 Rockefeller Plaza
New York, N. Y. 10020

Miscellaneous aviation information

29. Edison National Historic Site
P. O. Box 126
Orange, New Jersey 07051

Photo loan of Edison's electrification

30. Edmund Scientific Company
1776 Edscorp Building
Barrington, N. J. 08007

Alternative Energy Sources
Les Averbach
242 Copse Road
Madison, California 06443

31. Energy Research and Development Administration
Office of Public Affairs
Washington, D. C. 20545

Union Carbide Corporation
Nuclear Division
P. O. Box 62
Oak Ridge, Tennessee

Solar energy
Atoms on the move
Energy films catalog

32. U.S. Energy Research and Development Administration
P. O. Box 62
Oak Ridge, Tennessee 37830

So What's New 1776-1976
Linage study energy chart
Set of energy booklets on energy education

33. Estes-A Subsidiary of Damon
Penrose
Colorado 81240

34. Experimental Aircraft Association, Inc.
P. O. Box 229
Hales Corners, Wisconsin 53130

Film library catalog
Project School Flight
Plans on building an airplane

35. The Franklin Institute
Research Laboratories
c/o Mr. Gunther Cohn
Philadelphia, Penn. 19103

Energy related information

36. Federal Aviation Administration
Aviation Education Staff
Washington, D. C. 20590

The airport-Its Influence on the community economy

37. Department of Transportation
Federal Aviation Administration
Aeronautical Center AAC-5
P. O. Box 25082
Oklahoma City, Oklahoma 73125

FAA Film Catalog and order blanks

38. Gates Learjet Corporation
Mid-Continent Aircraft
P. O. Box 7707
Wichita, Kansas 67277

PR on Gates

39. Folker-VFW Internal BV
2361 Jefferson Davis Highway 906
Arlington, Virginia 22202

Phamplets, pictures, books, specs.
historical and commerical

40. General Aviation Manufacturers Association
Suite 1215, 1025 Connecticut Avenue
Washington, D. C. 20036

General Aviation Education materials
Related information

41. General Dynamics-Quincy Ship Building Divisions
Attn: Market Development Department
97 East Howard Street
Quincy, Massachusetts 02169

LNG Ships
Shipbuilding

42. General Electric Company
c/o Grant Eberle
N-35
Cincinnati, Ohio 45215

43. Goodyear Aerospace Corporation
1210 Massillon Road
Akron, Ohio 44315

Profile-Spring 1977
Booklet on state of the art on blimps

44. Jeppesen/Sanderson
8025 East 40th Avenue
Denver, Colorado 80207

Aviation/Aerospace Education catalog
Learn more about Aviation and Space
Catalog of educational materials and supplies

45. Lockheed-Georgia Company
A Division of Lockheed Aircraft Company
Marietta, Georgia 30063

National Aeronautics magazine (complimentary copy)
C-5 Transport (phamplet)
"Hercules-Worlds Most Versatile Airlifter"

46. Lockheed Shipbuilding and Construction Company
2929 Sixteenth Ave. S.W.
Seattle, Washington 98134

Lockheed Pathways to the Stars (posters)

47. Mooney Aircraft Corporation
Louis Schreiner Field
Kerrville, Texas 78028

Glossies on Mooney 201
Promotional brochures

48. National Aeronautics and Space Administration
Educational Programs Division
Washington, D. C. 20546

Request for placement on educational publication list
Tremendous amount of information on the state of the art of space transportation

49. National Safety Council
425 N. Michigan Avenue
Chicago, Illinois 60611

Catalog & poster directory
Film Catalog

50. National Coal Association
Education Division
1130 Seventeenth St. N. W.
Washington, D. C. 20036

51. Newport News Shipbuilding
Newport News
Virginia 23607

Information on shipbuilding

52. Piper Aircraft Corporation
Lock Haven
Pennsylvania 17745

"How an Aircraft is Made"

53. Pratt & Whitney Aircraft of Canada, Ltd.
Box 10 Longwell
Quebec, Canada
Attn: Dept. Publications Services

Copy of "PT 6A-27" (Jet engine descriptive notes)

54. R.C.A. Engineer
Bldg. 108-112
Moorestown, New Jersey 08057

Man and Space brochure
R.C.A. Space programs

55. Rolls-Royce Aero Engines, Inc.
375 Park Avenue
New York, N. Y. 10022

"How a Jet Engine Works"

Application brochures
Large cutaway pictures

56. Schweizer Aircraft Corporation
Box 147
Elmira, New York 14902

Soaring phamplet
"Soaring-The SSA and You"

57. Shell Oil Company
One Shell Plaza
P. O. Box 2463
Houston, Texas 77001

"Story of Petroleum"
"Let's Collect Rocks & Shells"
"Shell's Wonderful World of Oil"

58. Smithsonian Institute
c/o Bill Jackson, R. 3108 NASM
Washington, D. C. 20560

A variety of free phamplets available on the exploration of flight, i.e. Lilienthal, Chanute, the Wright Brothers, etc.

59. Sperry Flight Systems
P. O. Box 21111
Phoenix, Arizona 85036

"The Gyroscope Through the Ages" (excellent book)

60. Standard Oil Company
Director Youth and Educational Activities
ManCooe 3705
200 East Randolph Drive
Chicago, Illinois 60601

"This is Standard Oil" (brochure)
Set of 5 reading/questionnaires/ditto masters

61. Teledyne CAE
Turbine Engines
1330 Laskey Road
Toledo, Ohio 43612

Characteristics of Turbojets
History & performance of Teledyne turbines

62. Teledyne Continental Motors
Aircraft Products Division
Communications Department
P. O. Box 90
Mobile, Alabama 36601

Educational material listing

63. Thickol Chemical Corporation
Chemical Division
780 N. Clinton Avenue
Trenton, N. J. 08607

Numerous updates on new ideas in transportation vehicles

64. U. S. Government Printing Office
Public Documents Department
Washington, D. C. 20402

Highway Construction
Mass Transit Travel & Tourism
Motor Vehicles
Shipping & Transportation
Also available; posters, charts, picture sets, decals, etc.